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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 : G06F X	A2	(11) International Publication Number: WO 91/07715
		(43) International Publication Date: 30 May 1991 (30.05.91)

(21) International Application Number: PCT/US90/06631

(22) International Filing Date: 13 November 1990 (13.11.90)

(30) Priority data:
436,079 13 November 1989 (13.11.89) US
436,080 13 November 1989 (13.11.89) US

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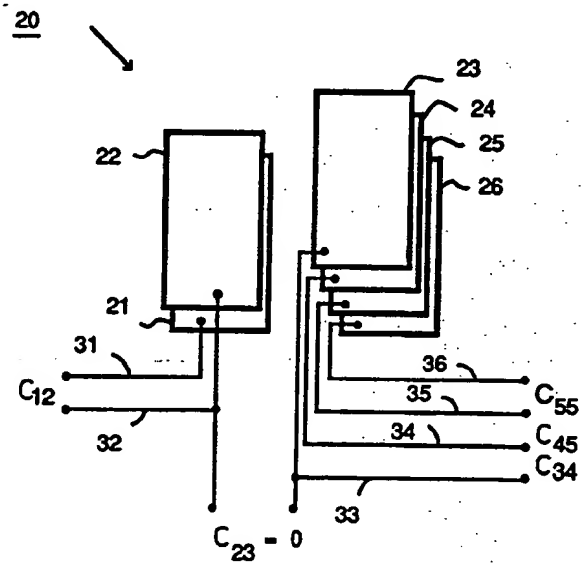
(81) Designated States: AT (European patent), BE (European patent), CA, CH (European patent), DE (European patent), DK (European patent), ES (European patent), FR (European patent), GB (European patent), GR (European patent), IT (European patent), JP, LU (European patent), NL (European patent), SE (European patent).

Published
Without international search report and to be republished upon receipt of that report.

(54) Title: DATA ENTRY BOOK WITH SHEET IDENTIFICATION



(57) Abstract

A data book (20, 40, 110, 171, 200, 310, 340, 440) for use in data entry device includes a plurality of substrates (81-86, 120, 155, 180, 190, 231-235, 271, 345-367) having thin electrical elements (12, 17, 34) thereon. The substrates are movable with respect to each other to provide a plurality of configurations. The substrates and the electrical elements cooperate to provide electrical properties therebetween which may be sensed to determine substrates separation and provide the system with information to cause its mode of operation to correspond with the page opened. In several embodiments, the substrates are arranged in pageable books (40), tablets (210), sheet arrays (371), and exchange booklets (440).

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DATA ENTRY BOOK WITH SHEET IDENTIFICATION

SPECIFICATION

Technical Field

This invention is related generally to data entry devices such as keyboards and the like, and particularly to those operative with multiple overlays for manual relabeling and automatic reassignment of the data entry device keys.

Background Art

Data entry devices as a general category vary substantially in structure. However, the most known human operated data entry devices provide a plurality of depressible keys coupled to a computer system or the like. Such typical data entry devices include computer keyboards and telephone dialer keypads. Early computer keyboards included an array of alpha-numeric keys and several function keys. Each key carried a designated input data and a fixed key-top label. As the development of computer systems and data entry systems continued however, the sophistication and complexity of input information correspondingly increased. It soon became apparent to practitioners in the art that the solution to increased complexity of data input could not be met by simply increasing the number of keys. In response to this need, practitioners developed data entry devices in which the same keys were capable of being assigned multiple code reflecting the label alteration. These devices are often referred to in the art as key-reassignment and relabeling keyboards. Such keyboards are used with a plurality of interchangeable overlays which cover the depressible keys and bear visible indications of the input codes assigned to the underlying keys. For example, an overlay for use in a restaurant may provide visual indication of the Sunday menu available. Depressing the key corresponding to an item indicated in the overlay provides a signal which the system responds to ring up the price and identification of the item. Thus, a great

deal of information may be provided to the system by depressing of a single key. When an overlay is changed, the operator informs the system by loading a new program or by entering an overlay associated code.

While such multiple overlay systems provide some improvement in the flexibility and complexity of data entry devices, they are also subject to limitations in terms of the amount of input information which can be processed efficiently. To meet the further increased needs, practitioners in the art have developed multiple paged data entry devices in which a number of sheet overlays may be interchangeably used for manual relabeling and automatic key-reassignment. One such device is set forth in U.S. Patent 4,661,976 entitled AUTOMATIC TELEPHONE DIALER UTILIZING AN ELECTRONIC TELEPHONE BOOK used April 28, 1987 to Basch. It comprises an automatic telephone dialer in which a plurality of sheets are supported upon a common base. Each sheet includes a plurality of telephone listings. An optical sensing array detects the open sheets of the sheet array. The information indicating the open sheets is provided to the system for key-reassignment.

A somewhat similar device is set forth in the February 1985 issue of the publication entitled HIGH TECHNOLOGY in an article at page 69 thereof written by Cary Lu.

While the foregoing described prior art devices provide key-reassignment and relabeling for data entry devices, they are subject to generally several disadvantages. It has been found for example that such devices tend to be larger than necessary to accommodate one optical detector for each sheet. In addition, the optical detectors and their high power consumption render the production of slim design or pocket model data entry devices impractical. Furthermore, substantial limitations arise as to the number of pages which can be accommodated and sensitivity of the optical devices to page damaged and ambient light.

Disclosure of the Invention

Accordingly, it is a general object of the present invention to provide an improved data entry devices. It is a further object of the present invention to provide an improved data entry

device which may be readily fabricated as a data entry book and which may be easily and inexpensively constructed.

In accordance with the present invention, there is provided an automatic key-reassignment and manual relabeling data entry device in which a plurality of sheets are assembled in a data entry device wherein the sheets support electrical elements. Means are provided which support the sheets within the device such that the electrical elements of the sheets overlie each other and form a multiple element capacitor. Connection means are provided between the electrical elements and the electrical interface where the capacitance between the sheets may be measured to determine the open sheets or the open sheet arrays of the device.

Brief Description of Drawings

The features of the present invention, which are believed to be novel, are set forth with particularity in the appended claims. The invention, together with further objects and advantages thereof, may best be understood by reference to the following description taken in conjunction with the accompanying drawings, in the several figures of which like reference numerals identify like elements and in which:

FIG. 1 sets forth a perspective view of a pair of typical data entry book sheets constructed in accordance with the present invention;

FIG. 1a sets forth a perspective view of a typical array divider constructed in accordance with the invention;

FIG. 2 sets forth a pictorial diagram of a plurality of data entry book sheets;

FIG. 3 sets forth a perspective view of a data entry book constructed in accordance with the present invention;

FIGS. 4 and 4a set forth a plurality of data sheets for the embodiment of the present invention shown in FIG. 3;

FIG. 5 sets forth a portion of the embodiment of the present invention data entry book shown in FIG. 3;

FIG. 5a sets forth a Key-Reassignment Table used with the present invention;

FIG. 6 sets forth an alternate embodiment of the present

invention data entry book;

FIG. 7 sets forth exemplary data sheets for the embodiment of the present invention data entry book shown in FIG. 6;

FIG. 8 sets forth a perspective view of the sheet tail cover for the data entry book shown in FIG. 6;

FIG. 9 sets forth a passive insert suitable for use with the embodiment of FIG. 6;

FIG. 10 sets forth an alternate embodiment of the present invention data entry book;

FIG. 11 sets forth a pair of sample sheets used in the embodiment of the present invention data entry book of FIG. 12;

FIG. 12 sets forth a plurality of data sheets assembled for use with the embodiment shown in FIG. 15;

FIG. 13 sets forth a partial section view of assembled data sheets of FIG. 12 taken along section lines 13-13 in FIG. 12;

FIG. 14 sets forth a partial section view of the data entry book of FIG. 15 taken along section lines 14-14 in FIG. 15;

FIG. 15 sets forth a perspective view of an alternate embodiment of the present invention data entry book;

FIG. 16 sets forth a perspective view of an insert sheet compatible with the present invention data entry book;

FIG. 17 sets forth a section view of a pair of sheets for use in a data entry book;

FIG. 18 sets forth a section view of a portion of the present invention taken along section lines 18-18 in FIG. 15, and a partial expanded view of FIG. 23a;

FIG. 19 sets forth a perspective view of a plurality of data sheets and array dividers arranged in accordance with the invention;

FIG. 20 sets forth a simplified front view of the plurality of sheets of FIG. 19 with book covers and spine added;

FIG. 21a, 21b, and 21c set forth three operative positions of data book of FIG. 20 employing array dividers;

FIG. 21d sets forth an array identification arrangement employing floating dividers;

FIG. 21e sets forth an electrical equivalent capacitance network of the arrangement in FIG. 21d;

FIG. 22 and 22a set forth exchange booklets;

FIG. 22b and 22c set forth booklet flap positioning for

automatic booklet identification;

FIG. 22d and 22e set forth electrical equivalent capacitance networks of the arrangements in FIG. 22b and 22c;

FIG. 23 sets forth a top view of a data entry book with a sheet array constructed in accordance with the invention;

FIG. 23a sets forth a sectional view of the data entry book taken along section lines 23a-23a in FIG. 23; and

FIG. 23b sets forth a portion of the embodiment of the present invention data entry book shown in FIG. 23.

Description of the Preferred Embodiments

FIG. 1 sets forth the perspective view of a pair of exemplary sheets generally referenced by numerals 10 and 15 constructed in accordance with the present invention data entry book. Sheet 10 includes a base layer 11 and a conductive layer 12 covered with an insulative layer 13. Base layer 11 is formed of an insulative material such as paper or plastic or other suitable materials and insulative layer 13 may be formed of any convenient sealing material such as plastic or the like. While conductive layer 12 may be formed of any number of conductive coatings it has been found practical to use a conventional binder blended with metallic powder or carbon black or graphite. In addition, other conductive and semi-conductive coatings or layers may be used. Conductive layer 12 and insulative layer 13 may be fabricated using any of the presently available techniques. Sheet 10 further defines an outwardly extending tail 14. In accordance with an important aspect of the present invention set forth below in greater detail, a portion of the conductive layer 12 in the tail area is electrically exposed and defines the sheet terminal 27 available for electrical connection to an external electrical element. In addition, while the embodiments set forth herein use single conductive or semi-conductive areas on each sheet, it should be understood that the sheets shown may each support multiple conductive and/or semi-conductive areas each having a separate coupling tail without departing from the invention.

Sheet 15 is of similar construction to sheet 10 and includes a base layer 16, a conductive layer 17, an insulative layer 18,

an outwardly extending tail 19 and a sheet terminal 28. For reasons set forth below in greater detail, it should be noted that tails 14 and 19 of sheets 10 and 15 are spaced apart by a sufficient distance to avoid contact between any exposed portions of conductive layers 12 and 17 and to minimize the parasitic capacitance therebetween. Tail 19 is made longer than tail 14 for reasons shown in FIG. 3.

Sheets 10 and 15 are superimposed and thus comprise a parallel plate capacitor whose capacitance is defined by the overlapping area of conductive layers 12 and 17, the distance between the same layers which is the thickness of base 16 (sheet 15) plus the thickness of insulating layer 13 (sheet 10), and finally defined by the dielectric constant of the base material and the insulating material. It will be apparent to those skilled in the art that deleting the insulative layer will increase the capacitance.

While the sample structures of sheets 10 and 15 set forth in FIG. 1 show conductive layers and insulative layers which are virtually coextensive with base layers 11 and 16, it will be understood by practitioners in the art after reading the descriptions which follow that the conductive and insulative layers of sheets 10 and 15 need not be coextensive with base layers 11 and 16 respectively. It should be noted that tails 14 and 15 can be deleted and replaced by leads or wires electrically bonded to conductive layers 12 and 17. Conductive layers 12 and 17 represent electrical elements. They can take different forms and functions, as explained below. Within the scope of this invention, sheets 10 and 15 are also used as an element of a book and as such they have the quality of being writable, printable, readable on the both sides. Writing paper such as typical "Bond" paper as well as some plastic films satisfy the above requirements. For specific applications, sheets 10 and 15 may take different forms. For example, they may form plastic pockets for storage of index cards and the like.

FIG. 2 sets forth a simplified view of an array of sheets generally referenced by numeral 20 together with appropriate interconnections. It should be understood that FIG. 2 is a simplified drawing used to explain the basic operative principle of the present invention data entry book. Therefore, reference

is invited to the figures and descriptions which follow for more detail understanding of the construction of the present invention data book. Sheet array 20 includes a plurality of generally planar sheets 21, 22, 23, 24, 25 and 26. Sheets 21-26 should be understood to be constructed in general accordance with sheets 10 and 15 of FIG. 1 in that they comprise individual base layers which support conductive material and insulative material arranged in accordance with FIG. 1. (The notation "21-26" is an abbreviation for 45, 46 and 47. It is used for other elements also throughout the specification.) Sheet 21 further includes a conductive tail or lead 31 which should be understood to form a conductive electrical connection to the conductive layer of sheet 21. Similarly, sheets 22-26 include connecting leads 32-36 respectively which form corresponding electrical connections to the individual conductive layers of sheets 22-26 respectively. In the position shown in FIG. 2, sheets 21 and 22 have been "turned" or paged over from the remainder of sheets 23-26. Thus, FIG. 2 depicts the configuration of sheets 21-26 which arises when the present invention data entry book is open to show sheets 22 and 23, for example, the sheets are physically and visibly accessible to the operator. In this position, conductive layers of sheets 21 and 22 produce a capacitance C12 therebetween which may be detected or measured between connecting leads 31 and 32. Similarly, the conductive layers of sheets 23-26 produce a series of intersheet capacitances which may be measured or detected between leads 33-36 respectively. In contrast however, the separation between sheets 22 and 23 provides virtually no capacitance therebetween and thus the capacitance C23 measured or detected between leads 32 and 33 is virtually zero. Thus in the arrangement shown in FIG. 2 and in accordance with an important aspect of the present invention, the measurement of intersheet capacitance between connecting leads 31-36 permits the determination of the relative position of sheets 21-26 due to the occurrence of the near zero capacitance between sheets 22 and 23. Simply stated, the zero intersheet capacitance locates the open sheets of sheet array 20. It will be apparent to those skilled in the art that despite careful structures and methods of fabrication set forth below to minimize the stray capacitances produced between connecting leads

31-36 and the open sheets 22 and 23, some unwanted capacitance is inevitable. Accordingly, and in accordance with the preferred fabrication of the present invention, the relative areas of conductive materials and other capacitance determining parameters of sheets 21-26 are selected to provide capacitances between overlying pages which are substantially greater than the unwanted capacitances within the data entry book. It should be noted that the arrangement of FIGS. 1 and 2 can be incorporated in different embodiments. In the examples to follow, similar sheet arrays are included in a loose-leaf binder, a notebook and the like.

FIG. 3 sets forth a typical data entry book generally referenced by numeral 40 and constructed in accordance with the present invention. Data entry book 40 includes a pair of book covers 41 and 42. Covers 41 and 42 are movably joint by a trio of binder rings 43, 44 and 45. Cover 42 supports a plurality of connecting pads 51-56. To minimize parasitic capacitances, pads 51, 53 and 55 are arranged along the lower edge of cover 42 while pads 52, 54 and 56 are arranged in a row near the upper edge of cover 42. Cover 42 supports an electrical interface 68 which includes book connector 60 with connector pins or fingers 61-66 arranged along the upper edge. An electro-optical display (not shown) and electrical components 68 are also typically included in the electrical interface. A plurality of conductors 71-76 provide electrical connections between fingers 61-66 and connecting pads 51-56 respectively. A plurality of sheets 81-86 constructed in accordance with sheets 10 and 15 shown in FIG. 1 are movably supported upon binder rings 43-45 by a plurality of conventional binder apertures. Sheets 81-86 define extending tails 91-96 respectively in further accordance with the structure shown in FIG. 1. Accordingly, sheet 86 defines an outwardly extending tail 96 having a length sufficient to reach connecting pad 56. Correspondingly, sheet 84 defines an outwardly extending tail 94 having a length sufficient to reach connecting pad 54 and sheet 82 defines an outwardly extending tail 94 having a length sufficient to reach connecting pad 52. It should be noted that tails 92, 94 and 96 each defines a sheet terminal similar to sheet terminals 27 and 28 of sheets 10 and 15 in FIG. 1. Thus, the overlap of tail 96 upon connecting pad 56 provides an

electrical connection between the conductive layer of sheet 86 and pad 56. Similarly, the sheet terminal on tail 94 provides an electrical connection between pad 54 and the conductive layer of sheet 84. Finally, the sheet terminal on tail 92 provides an electrical connection between the conductive layer of sheet 82 and connecting pad 52. In operation, tails 92, 94, and 96 are folded downwardly and pressed against cover 42, thus, electrical connections are established between the conductive layers of sheets 82, 84 and 86 and the connecting pads 52, 54 and 56.

In similar fashion, sheets 81, 83 and 85 define outwardly extending tails 91, 93 and 95 respectively, which, in accordance with the foregoing description, provide electrical connection between pads 51, 53, and 55 and the conductive layers of sheets 81, 83 and 85 respectively. The capacitances between sheets 81-86 may be readily measured at connector fingers 61-66 of book connector 60. In data entry devices utilizing a greater number of sheets and corresponding electrical connection lines, electrical interface 68 may include a parallel to serial converter, or a multiplexor, or an encoder (generally indicated by 68') to reduce the number of external connections required. In accordance with an important aspect of the present invention, the data entry book shown in FIG. 3 may be paged such that sheets 81-86 overlie each other and are stacked upon cover 41. Alternatively, sheet 86 may be "paged over" to overlie cover 42 in which case sheet 86 is separated from sheets 85-81. In such case, examination of the capacitances between sheets 81-86 at connector fingers 61-66 provide a zero capacitance between sheets 85 and 86 and thus indicates that the data entry book is open to sheets 85 and 86. By similar examination, the alternative positions of sheets 81-86 may be determined by the presence of zero capacitance between any two consecutive sheets of the data entry book. Absence of zero capacitance indicates that all sheets (the book) are (is) closed. It should be noted that cover 41 can bear an electrical element, or capacitor plate connected to a connector finger, permitting identification of front cover relative position.

FIG. 5 sets forth covers 41 and 42 with pages 81-86 and binder rings 43-45 removed, however, depressible key arrays 100 and 101 are added. Cover 42 supports a plurality of depressible

keys 101 arranged in an equally spaced row near the inner edge of cover 42. The first two keys are marked 101-1 and 101-2. Correspondingly, cover 41 supports a second plurality of keys 100 arranged along the inner edge of cover 41. Multiple conductor sets 77 and 78 provide electrical connection from keys 100 and 101 to book connector 60. Via book connector 60, electrical contact with an external system (not shown) is provided.

A major objective of the present invention is relabeling and reassignment of data entry keys. In order to relabel the key 101-1 in FIG. 5, for example, this invention provides solutions exemplified in FIG. 4 with a five-sheet array 81-85 as a part of a book 40. The sheets carry alpha-numeric, graphical, or other type of information 109 as a label/symbol which is readable or in other way recognizable by the operator. In operation, the five-sheet array 81-85 is assembled with the data book parts shown in FIG. 5. The label for key 101-1 changes when a sheet is turned to expose the next or the previous sheet. This is illustrated in FIG. 4 where sheet 81 is on top of sheets 82-85 and displays the letter "A" as a label/symbol 109 for key 101-1. The label changes to "B" on sheet 82 and to "C" on sheet 83 as illustrated in FIG. 4a. It should be noted that labels A, B and C are associated with key 101-1. The second label "GO" on sheet 81 is associated with the second key 101-2. This label changes to "STOP" on sheet 83. The labels used in this example and their locations are listed in FIG. 5A KEY-REASSIGNMENT TABLE, column LABEL. A mark 108 next to each label/symbol 109 coincides with an underlying key in operational position and indicates the area to be depressed by the operator to actuate that underlying key. In this way, the present invention makes it possible to incorporate a plurality of interchangeable labels, for example, 20, 50 or more labels on top of an entry key and in addition provides each label with ample space for printed or handwritten information to assist the operator and speed up the data entry. Another major objective of the invention is to provide the system information as to the sheet bearing the selected label. The arrangement described in connection with FIG. 3 provides zero-capacitance information permitting identification of the open sheet(s) bearing the selected label(s). It should be noted that in addition to zero-capacitance information, the arrangement of

FIG. 3 provides alternative information for open page identification. This occurs when the operator touches the open sheet to depress the underlying key. His body capacitance and resistance (to ground) alter the sheet's own capacitance and resistance. This new electrical condition is measurable at the respective connector finger. With known in the art methods, the touched sheet is identified. A further alternative arrangement for open sheet identification is disclosed in connection with FIG. 17.

When a label is selected and the underlying key is actuated, information is provided for the key number and the opened sheet numbers. In FIG. 5A, Key-Reassignment Table, line one reflects the events taking place when the operator strikes label "A" on sheet 81. The book is sending data indicating that "NONE" sheets were open and the depressed key was number 101-1. Accordingly, the system assigns key number 101-1, label "A". Further, the table indicates that any one of the aligned labels - "A, B, C, D, E" can be assigned to key 101-1.

Summarizing, the sheets as visual information bearer on top of the keys provide the relabeling capability and the same sheets as electrical elements in cooperation with the keys provide the key-reassignment capability. It would be apparent to those skilled in the art that keys 100 and 101 need not be supported beneath sheets 80-85, but may be located at any convenient place.

FIG. 6 sets forth an alternate embodiment generally referenced by numeral 110 and having a pair of covers 111 and 112 joint by a spine 117. In accordance with conventional book fabrication covers 111 and 112 are pivotally attached to spine 117 and may be opened and closed accordingly. A pair of binder assemblies 113 and 114 constructed in accordance with conventional fabrication techniques are secured to and supported upon spine 117. Binder 113 includes a split binder ring 115 while binder 114 includes a split binder ring 116. The rings are of plastic or metal coated with an insulative layer. A plurality of data entry book sheets 120-123 are received upon binder rings 115 and 116 and stacked upon cover 111. Sheet 123 defines a pair of apertures 125 and 126 receiving binder rings 115 and 116 respectively to secure sheet 123 within data entry book 110. A slot 127 extends parallel to the interior edge of

sheet 123. While not visible in FIG. 6 sheets 120, 121 and 122 are similar to sheet 123 and supported beneath sheet 123 in the position shown in FIG. 6. Sheet 123 defines an extending tail 133 which extends laterally from the interior portion of sheet 123 and is conductibly coupled to a connecting pad (not shown) in cover 112 in a similar fashion to the embodiment in FIG. 3. Correspondingly, data entry book sheets 120-122 define extending tail portions 130-132 respectively. Tails 130-132 form similar conductive attachments to the interior of cover 112 to provide electrical connections. In accordance with the invention, sheets 120-123 include similar conductive and insulative layers to that set forth above and are operative in the same manner as the alternate embodiments described above. A generally cylindrical tail cover 140 is secured to spine 117 to provide a protective overlay for tails 130-133.

In operation, data entry book 110 functions in much the same manner as the above described embodiments. The primary difference in the embodiment of FIG. 6 from those described above is the location of tails 130-133 near the center of sheets 120-123 and a protective tail cover 140.

FIG. 7 sets forth sheets 120 and 123 of the embodiment of FIG. 6 in greater detail.

FIG. 8 sets forth tail cover 140 of insulating material which as can be seen comprises a generally cylindrical member 141 having a plurality of outwardly attachments tabs 142-145 inclusive. Tabs 142-145 are attached to spine 117.

Split binder rings 115 and 116 allow for quick removal and insertion of sheets in the data book. FIG. 9 sets forth an insert sheet 155 with two apertures 156 and 157, and a notch 158. Sheet 155 may be removably engaged to the data book by using only split rings 115 and 116. Notch 158 provides clearance between edge of sheet 155 and tail cover 140 to permit insert sheet 155 to be freely moved upon split rings 115 and 116.

It should be noted that insert sheet 155 is made of insulative material and does not carry any conductive layer. Its presence between sheets 122 and 123 will change the intersheet capacitance therebetween. Insert sheet 155 can provide supporting visual information. Another type of insert sheet which does not influence the intersheet capacitance is disclosed

in FIG. 16.

FIG. 10 sets forth an alternate embodiment of the present invention data entry book with spiral binding and sheet segments generally referenced by numeral 171. A data sheet 170 defines a plurality of apertures 173 positioned along the interior edge to receive spiral wire 177. Data sheet 170 includes an extending tail 174. A segment data sheet 180 defines apertures 183 which receive spiral wire 177. A second segment data sheet 190 completes the remaining portion to provide the equivalent of full sheet such as sheet 170. Segment data sheet 190 defines apertures 193 along the interior edge to receive spiral wire 177. In accordance with an important advantage of the embodiment shown in FIG. 10, data sheets 170, 180 and 190 are individually movable with respect to book covers (not shown) and the remainder of data sheets to provide partial paging of the data sheets. For example, segment data sheet 190 may be individually moved apart from segment data sheet 180 to overlie a portion of sheet 170 as indicated by dash line 186. Similarly, sheet 180 may be moved with respect to sheet 190 to overlie data sheet 170 as is also indicated by dash line 186. Data sheet 180 includes a tail 184. Similarly, sheet 190 defines an extending tail 194. It should be understood that while not shown in FIG. 10, tails 174, 184 and 194 are electrically connected to a book connector and sheets 170, 180 and 190 are formed in the same manner as sheets 10 and 15 in FIG. 1, and accordingly each define a base layer, a conductive layer, and an insulative layer. Specifically, it should be understood that data entry book 171 supports a plurality of depressible keys in the book covers and functions substantially in accordance with the above-described operation of data entry book 40 in FIGS. 3, 4 and 5.

FIGS. 11, 12 and 13 set forth a label tablet 210 which is a collection of data sheets 230-235 glued together at one edge. The label tablet 210 is removably attachable to base 201 of FIG. 15. As set forth in FIG. 12, the label tablet 210 includes a plurality of data sheets 230-235 arranged in a stack. Data sheet 230 includes an upwardly extending tail 240 and defines a notch 246 along its upper edge (better seen in FIG. 11). Sheet 231 is positioned beneath sheet 230 and defines an upwardly extending tail 241. Sheet 231 defines a

notch 247 generally coincident with notch 246. It should be noted that tail 241 of sheet 231 is spaced inwardly from tail 240 of sheet 230 to reduce intertail parasitic capacitance. Sheet 232 which underlies sheet 231 defines an upwardly tail 242 and a notch similar to notch 246 of sheet 230. Tail 242 underlies tail 240 and is of reduced length with respect to tail 240. Sheet 233 underlies sheet 232 and defines a notch similar to notch 247 of sheet 241 and an upwardly extending tail 243 which underlies and is shorter than tail 241 of sheet 231. Similarly, sheet 234 underlies sheet 233 and defines a notch similar to notch 246 and an upwardly extending tail 244 which underlies tails 242 and 240 and is shorter than tail 242. Finally, sheet 235 underlies sheet 234 and defines a notch similar to notch 247 and an upwardly extending tail 245 which underlies tails 241 and 243 and is shorter than tail 243. Summarizing, the tails of sheets 230-235 progress with alternating sheets having offset tails and successively shorter lengths of tails to provide the structure shown in FIG. 11. It should be noted that the notches 246, 247 etc. act as strain relief in tail - sheet junction. The sheets 230-235 are glued together by means of a strip 205 as shown in the cross sectional view in FIG. 13. The glue holds the upper edges of all sheets and a small portion 239 of the front surface of the sheets. Strip 205 comprising a generally planar member, the structure of which is set forth in greater detail in FIGS. 12 and 13, defines a pair of apertures 225 and 226 which receive pins 236 and 237 respectively extending upwardly from base 201 (seen in FIGS. 14 and 15). Strip 205 secures the upper edges of sheets 230-235 to form a tablet like binding which maintains sheets 230-235 in the position shown in FIG. 12. It should be noted that sheet 230 bears a plurality of ruled spaces 252 arranged across the sheet. In addition, sheet 230 supports a plurality of visual information legends such as the numbers 251 shown together with visually marked key-press indicia 250. Thus sheet 230 is provided with a plurality of spaces 252 upon which the visually imparted information relating to the particular key-press indicia is available to the operator. It should be understood that sheets 231-235 bear similar markings to those shown for sheet 230, and that sheets 230-235 are constructed in accordance with sheets 10 and 15 shown in FIG. 1.

FIG. 15 sets forth a data entry table support referenced by numeral 200. A generally planar base 201 defines a planar flexible cover 203 which supports a plurality of connecting pads 215-220. Connecting pads 215, 216 and 217 are arranged in an evenly spaced vertical row, while connecting pads 218, 219 and 220 are arranged in a similar row parallel to pads 215-217. It should be understood that in accordance with the above-described structure, connecting pads 215-220 are coupled to conductors (not shown) which provide electrical connection to tablet support connector 202 for coupling to outside devices. It should be noted that in accordance with the above-described fabrication techniques, tails 240, 242 and 244 are electrically connected to connecting pads 215, 216 and 217 respectively. Similarly, tails 241, 243 and 245 are electrically connected to connecting pads 218, 219 and 220 respectively. Accordingly, the conductive layers of sheets 230-235 are individually connected to pads 215-220. A generally planar cover plate 204 is attached to base 201 at a hinge 214. Hinge 214 permits cover plate 204 to be pivotally rotated from the open position shown in FIG. 15 to a close position in which cover plate 204 overlies strip 205 and tails 240-245. Cover plate 204 further defines a pair of apertures 212 and 213 spaced upon cover 204 to receive the extensions of pins 236 and 237 extending beyond strip 205. Thus the cooperation of apertures 212 and 213 with pins 236 and 237 is operative to secure cover 204 in the close position. In addition, a resilient pad is secured to the underside of cover 204 and positioned thereon such that resilient pad 211 overlies the connections of tails 240-245 upon connecting pads 215-220. Thus in the closed position, the resilient force provided by resilient pad 211 maintains a short contact between tails 240-245 and their respective connecting pads 215-220. In accordance with an important aspect of the embodiment shown in FIG. 15, the rotation of cover 204 to the open position permits the easy removal and replacement of label tablet 210. A plurality of depressible keys 265 are arranged in a vertical row across flexible cover 203 of base 201. The structure of keys 265 is set forth below in greater detail. However, suffice it to note here that virtually any structure may be utilized without departing from the spirit and scope of the present invention. With

simultaneous reference to FIGS. 12 and 18, it should be noted that keys 265 are spaced and arranged upon or beneath flexible cover 203 to underlie key indicia 250 of data sheets 230-235. Thus depressing the selected key indicia 250 on data sheets 230-235, results in depressing the underlying one of keys 265. Base 201 further supports a plurality of numeric keys 207 together with a plurality of function keys 208. Keys 207 and 208 provide for additional input of information and functional configuration. As shown, they are not relabelable nor reassignable. It will be apparent to those skilled in the art that keys 265 need not be supported upon or beneath label tablet 210 but may instead be located at any convenient place. FIG. 16 sets forth a perspective view of a sheet generally referenced by numeral 270 which includes an insulative base 271, a conductive layer 272 on one side of the base and a conductive layer 273 on the other side. Conductive layers 272 and 273 are electrically connected by a plurality of connecting elements 274. Thus the conductive layers 272 and 273 of sheet 270 are electrically continuous. In accordance with the invention and for a specific application, sheet 270 is made to size and shape of sheet 155 in FIG. 9 and is inserted between sheets 122 and 123 in FIG. 6 instead of sheet 155. Because conductive layers 272 and 273 are conductively coupled by connecting element 274 and remain free of any external electrical connection, the resulting capacitance produced by the sheets 122 and 123 in FIG. 6 remains substantially the same as that achieved without sheet 270 inserted therebetween. Thus in accordance with an important aspect of the present invention, any number of insert sheets constructed in accordance with the structure shown in FIG. 16 may be inserted within the array of data sheets in the present invention data entry book without substantial change in the resulting capacitances between data sheets. Sheet 270 is a double sided conductive layer coated sheet and can also be applied as a data sheet such as sheet 10 of FIG. 1 or any other disclosed herein. An example is set forth below.

FIG. 17 sets forth sheet 270 overlying sheet 280. Sheet 280 exhibits structure which is similar to sheet 270 including insulative base 281 and conductive layers 282 and 283 on each face and an interconnection 284 therebetween. Schematically

presented are tail 275, as an extension of sheet 270 and tail 285 as an extension of sheet 280. Tails 275 and 285 carry conductive layers (not shown but similar to those of FIGS. 1 and 3) for connection to external devices. In FIG. 17, sheets 270 and 280 are superimposed and conductive layer 273 of sheet 270 makes direct contact with conductive layer 282 of sheet 280. Accordingly, a significant conductance G12 can be measured between tails 275 and 285. Accordingly, when the sheets are open the conductance is zero. It will be apparent to those skilled in the art that using double side conductive layer sheets without insulating layers, such as sheets 270 and 280, in constructions described above, will achieve the same objective of the invention such as open sheets identification. Consequently, replacing the terms capacitance, zero capacitance and non-zero capacitance as used above by conductance, zero conductance and non-zero conductance, will specify the conditions for use of double sided conductive layer sheets without insulating layers.

According to the present invention, information is provided to the system identifying a selected sheet array within a data book. This object is achieved by applying sheet array sensing technique for automatic sheet array identification as disclosed below in two different embodiments shown in FIGS. 21a and 21d, respectively. Methods for record space (label) identification and sheet identification within the automatic identified array are covered in connection with FIG. 23.

The book sheets are divided into arrays by inserting dedicated array dividers such as 350, 360, and 370, of FIG. 19, representing divider means. Each divider means supports electrical elements, such as 334 of FIGS. 1a, which represent switch means for identification of a sheet array in operation. The automatic sheet array identification allows the use of sheet keys 391-394 with all sheet arrays within a data entry book, as explained below.

FIG. 19 is a perspective view of a group of sheets 380 that is used to explain the basic principle of sheet array sensing. The group 380 is divided into:

array 371 comprising sheets 345, 346 and 347, of FIG. 23,

array 372 comprising sheets 355, 356 and 357, and

array 373 comprising sheets 365, 366 and 367.

Sheets 345, 346, and 347 bear labels *"1-18"* shown in FIG. 23 Sheets 355, 356, 357, 365, 366, and 367, are made in accordance with sheets 345, 346, and 347, explained below, and are imprinted with labels *"19-54"* (partially seen). An array divider 350, shown in heavy line, is inserted between sheets 347 and 355. Similarly, array divider 360 is inserted between sheets 357 and 365. Finally, array divider 370 underlies sheet 367 of array 373. Each array divider carries a divider electrical element 334 to be explaind below.

Sheets 380 are employed as elements of a book and they have the quality of being writable, printable, readable on the both sides. Writing paper such as "Bond" paper as well as some plastic films satisfy the above requirements. They are provided with record spaces 332, sheet indexes 341, 342 explained below. In alternative embodiments for specific applications, sheets 380 may take different forms. For example they may form plastic pockets for the storage of index cards for index files, and the like. For specific applications sheets 380 may support a thin electrical conductive layer in accordance with FIG. 9 i.e. without connection.

FIG. 1a is a perspective view of a typical array divider 350. Array divider 350 includes a base layer 333, and a conductive layer 334, which is covered with an insulative layer 335. Base layer 333 is formed of a planar and insulating material such as paper, or plastic, or other suitable materials depending on specific application and design. The electrical conductive layer 334 is made of binder blended with metal powder, or carbon black, or graphite. It is applied on base 333 surface by any of the known in the art methods such as: spraying, silk-screening, printing, brushing, etc. Another alternative methods are metallizing the base layer 333 in vacuum, laminating the base layer 333 with a metal foil, and other methods known in the art. Conductive layer 334 may be formed of any number of conductive coatings. Insulating layer 335 is formed of sealing material such as plastic or paper, which functions as a protection against damage, as a dielectric in a capacitor, as an electric insulator, and as a printable, writable and readable surface.

In FIG. 1a the lower left portion of insulative layer 335 is partially removed to permit electrical bonding of lead (wire) 336

on the surface of conductive layer 334. Lead 336 is a divider connection means for connecting conductive layer 334 of divider 350 to connecting pad 379 located on rear cover 312 of FIG. 23b. The lead 336 is inserted via slot 328 into pocket 339 (seen in FIG. 23a). Electrical layer 334 of divider 350 is thereby connected to electrical interface 321.

FIG. 1 sets forth an alternative embodiment of divider connection means 336. Divider substrate 10 defines an outwardly extending tail 14 ellectrically exposed at 27 for electrical connection to an external connecting element such as connecting pad 379 located on rear cover 312, shown in FIG. 23b, and accessible via slot 328 in rear panel 316. Dividers 360 and 370 as shown in FIGS. 19 and 20 are of similar construction. Each divider has a divider connection means 336a and 336b for electrical connection to connecting pad 377 and 378, respectively. The divider tails on consecutive sheets are spaced apart by sufficient distance to avoid undesirable electrical contact threrebetween and to minimize parasitic capacitances. Dividers 350, 360, and 370, may be used also as information and record bearers when provided with sheet indexes and record spaces, similar to those of sheet 345-347.

Summary. FIGS. 1 and 1a show electrical conductive element 334 deposited on one side of the base 333, covering the whole base surface as shown in FIG. 1. Divider 350 and its elements such as base 333, divider electrical element 334, and insulative layer 335 may vary in the following ways: insulative layer 335

may be deleted;

divider electrical element 334 may be applied on both sides of base 333 ;

divider electrical element 334 may be applied only on a portion of base 333;

more than one electrical element 334 may be applied on either side of base 333, each element 334 having a lead, such as 336;

divider electrical element 334 can be made of conductive, semiconductive, resistive, or other materials which allow building of different elements and components such as: a capacitor plate, a capacitor, a conductive path, a resistor, or in combination of the above like an RC network etc.;

divider 350 may be formed of a single conductive layer sheet with or without insulative layers on either side;

lead 336 may be used for interdivider connections e.g. connecting elements of different dividers.

FIG. 20 sets forth a simplified front view of the plurality of sheets 380, of FIG. 319, with book covers 311 and 312, and spine 313 added, which in combination form data book 340. Sheets 380 are movably attached to spine 313 in the way explained above. Data book 340 is in a closed position. Sheets 380 are arranged as shown in FIG. 19. Further, they are stacked and aligned upon rear cover 312, and front cover 311 overlies sheet 345.

In this position, divider 350 and divider 360 are separated by sheet array 372 and form a parallel-plate capacitor 392, which defines capacitance C56. The capacitance value of capacitance C56 is determined: (a) by the overlapping areas of conductive layers 334 located on dividers 350 and 360 respectively; (b) by the distance between dividers 350 and 360 which is sheets 355, 356 and 357 combined thickness; and finally (c) by the dielectric constant of sheets 355, 356 and 357. Similarly, dividers 360 and 370 form parallel-plate capacitor 97. Capacitor 97 defines capacitance C67 which is calculated in the same way as capacitance C56.

Referring simultaneously to FIGS. 19, 20, 21a, 21b and 21c the embodiment is explained in greater detail. FIG. 21a illustrates data book 340, In operating position, laid down flat and is open to show sheets 346 and 347, of array 371. In this position arrays 372 and 373, and dividers 350, 360, and 370, are closed and are stacked upon rear cover 312. Accordingly, dividers 350 and 360, lie in parallel, separated by sheet array 372, forming capacitor 396 with capacitance C56. Similarly, dividers 360 and 370 lie in parallel separated by sheet array 373, thus forming capacitor 397 with capacitance C67. It should be noted that divider 360 participates in both capacitors 396 and 397. In this position (closed dividers), capacitors 396 and 397 have a capacitance value referred hereinafter as a maximum capacitance value, also characterized as $C56 \neq 0$ and $C67 \neq 0$.

In FIG. 21b, book 340 is laid down flat and open to show sheets 355 and 356, of array 372. In this position the book is separated into two stacks. In the left stack, divider 350

overlies array 371, which overlies front cover 311. In the right stack, divider 360 overlies array 373, which overlies divider 370, which overlies rear cover 312. In this position divider 350 is 180 degrees apart from divider 360, which reduces the value of capacitance C56 to a minimum capacitance value which is relatively small and characterized as C56 = 0. It is mainly defined by stray and parasitic capacitances of nearby conductors and components. Dividers 360 and 370 have not changed position and capacitance 367 remains at maximum value, or C67 + 0.

In FIG. 21c book 340 is open to show sheet 365 and 366, of array 373. Capacitance C67, between dividers 360 and 370, is at minimum value, or C67 = 0, while capacitance C56, between dividers 350 and 360, is at maximum value, or C56 + 0. In an alternative embodiment (not shown), divider 370 is incorporated in rear cover 312. Table 1 tabulates the capacitance values.

FIG. 21d sets forth an alternative array identification embodiment employing dividers 350' and 360', constructed as dividers 350 and 360, however, without lead or tail connection to electrical interface 321, i.e. floating dividers. Data book 340' is a similar construction of data book 340 of FIG. 21b. Corresponding reference numerals are printed (') and are explained as follows. Front cover 311' supports two capacitor plates 322' and 323' connected to electrical interface 321 (not shown) via wires 319g and 319h, respectively. Rear cover 312' supports two plates 324' and 325' connected to electrical interface 321 (not shown) via wires 319i and 319j, respectively. Dividers 350' and 360' comprise a base layer 333 of insulative material, and a conductive layer 334 which is covered with an insulative layer 335, as shown in FIG. 1a, and described accordingly. The dividers 350' and 360' are therefore electrically floating dividers. Record and sheet keys 381 -386, and 391-394, connection means 317, 318, and 319, and electrical interface 321 (all not shown) are included in data book 340'. Book 340' is opened to show any sheet of array 372'. Divider 350' overlies sheet array 371', which in turn overlies cover plates 322' and 323', supported by front cover 311'. In the right stack, divider 360' overlies array 373', which in turn overlies plates 324' and 325' supported by rear cover 312'. It should be noted that plates 322' and 323' are of equal length,

and their combined length approximately equals the length of divider 350'. Plates 322' and 323' are positioned such that the overlapping portion of divider 350' with plate 322' is approximately equal to the overlapping portion of divider 350' with plate 323'. Accordingly, capacitance C52 formed between plate 322' and divider 350' is approximately equal to capacitance C53 formed between plate 323' and divider 350'.

Divider 350' lies in parallel with plates 322' and 323', divided by array 371'. In this position two parallel-plate capacitors 402 and 403 are formed with capacitances C52 and C53, respectively, both exhibiting maximum capacitance value. Divider 350' is 397 common plate for both capacitors, meaning they are connected in series, as shown in FIG. 2le, with an equivalent capacitance less than the smaller of the two, C52 and C53. When divider 350' is turned to overlie the stack upon rear cover 312', capacitances C52 and C53 have near zero, or minimum capacitance value. Table 1 tabulates floating divider's capacitance values.

Table 1

Array Dividers In FIGS. 21a, 21b, 21c			Floating Array Dividers In FIG. 21d				
Open Array	Capacitance Value/Code		Open Array	Capacitance Value/Code			
	C56	C67		C52	C53	C64	C65
371	≠ 0	≠ 0	371'	= 0	= 0	≠ 0	≠ 0
372	= 0	≠ 0	372'	≠ 0	≠ 0	≠ 0	≠ 0
373	≠ 0	= 0	373'	≠ 0	≠ 0	= 0	= 0

Divider 360' lies in parallel with plates 324' and 325', divided by array 373'. In this position two parallel-plate capacitors 404 and 405 are formed with capacitances C64 and C65, respectively, both exhibiting maximum capacitance value. Divider 360' is 397 common plate for both capacitors, i.e. they are connected in series as shown in FIG. 2le, with an equivalent

capacitance less than the smaller of the two, C64 and C65.

When divider 360' is turned to overlie the stack upon front cover 311', capacitances C64 and C65 have near zero, or minimum capacitance value. In this embodiment, the relative position of a divider to a predetermined cover defines the capacitances' maximum and minimum values. These values form a code which is made available at interface 321.

FIG. 22 sets forth a typical exchange booklet 440 which is attachable to and detachable from data entry book 310 in FIG. 23b. This embodiment includes automatic identification of a particular booklet currently attached to book 310. It should be understood that FIG. 22 is a simplified drawing used to explain the basic operative principle of electrically identifiable exchange booklets. Booklet 440 includes a plurality of sheets 445, 446, and 447, constructed in general accordance with sheets 345, 346, and 347, of FIGS. 19 and 20. Accordingly, sheets 445, 446, and 447 bear 447 spaces 432 and sheet indexes 441 and 442. Further, booklet 440 includes a sheet or a flap 448 which should be understood is insertable through slot 326 into receiving pocket 338, best seen in FIG. 23a. Accordingly, flap 448 is formed of a planar, semiflexible and insulative material such as light cardboard, or plastic, or the like. A portion of flap 448 supports flap-capacitor plate 449 located near the upper edge. It should be noted that plate 449 is covered with an insulative layer (not shown), and both are fabricated in general accordance with the methods described above. Flap 449 and sheets 445-447 are glued together, or otherwise movably joint, along one edge in aligned position forming one single booklet. When flap 448 is inserted into receiving pocket 338, sheets 445-447 are aligned with the book covers 311 and 312. In this position, sheets 445-447 may be used in the way described in connection with FIGS. 23, 23b, 19, and 20.

FIG. 22a sets forth a second booklet of sheets generally referenced by numeral 450, including a plurality of sheets 455, 456, and 457, and a flap 458 with flap-capacitor plate 459. Booklet 450 is constructed similarly to booklet 440 in FIG. 22. Plate 459, as shown in FIG. 22a is located near the lower edge of flap 458.

FIG. 22b sets forth inside front book cover 311 (of FIG.23b)

with keys 384-386, sheet keys 393 and 394, and panel 314 removed. Cover capacitor plates 322, 323, and 324, are arranged in a column. They are constructed in general accordance with divider 350's capacitor plate of FIG. 1a. In addition, they are connected to electrical interface 321 via wires 319a, 319b, and 319c. When flap 148 is inserted into receiving pocket 338 (seen in FIGS. 23 and 23a), flap plate 449 (shown in broken line in FIG. 22b) overlies two adjacent cover plates 322 and 323. In this position, plate 322 and portion of plate 449 form a parallel-plate capacitor 411 with capacitance C24. Plate 323 and the remainder of plate 449 form a second parallel-plate capacitor 412 with capacitance C34. FIG. 22d is the equivalent electrical circuit for capacitors formed between flap plate 449 and cover plates 322-324. Since capacitors 411 and 412 have one common plate 442, they are connected in series, with an equivalent series capacitance C234 less than the smaller of the two, C24 and C34.

When flap 448 is extracted from pocket 38 and replaced by flap 458, flap-capacitor plate 459 overlies cover plates 323 and 324, as shown in dotted line in FIG. 22c. In this position plate 323 and portion of plate 459 form parallel-plate capacitor 413 with capacitance C35, while plate 324 and the remainder of plate 459 form parallel-plate capacitor 414 with capacitance C45. Accordingly, capacitors 413 and 414 are connected in series, as shown in FIG. 22e, with an equivalent series capacitance C345 less than the smaller of the two, C35 and C45.

In another embodiment (not shown) a flap-capacitor plate is made large enough to overlap all three cover plates 322, 323, and 324, thus, defining three simultaneously existing capacitors. In still another embodiment, the flap plate is fork-shaped made to coincide with cover plates 322 and 324, thus, defining a new capacitors' combination. It will be understood by those skilled in the art that increased number of cover plates and/or increased number of flap plates will result in larger number of capacitor combinations. Then, each combination is used for booklet identification by the system.

In an alternative embodiment, the capacitive coupling between flap and cover is replaced by direct electrical contact. For that purpose flap-capacitor plate 448 and cover-capacitor

plates 322-324 are at least partially free of insulative layer 335 (of FIG. 1a) to form a flap electrical-contact area, and a cover electrical-contact area, respectively (not shown). When flap 448 is inserted into pocket 328 in operative position, flap electrical-contat area, and cover electrical-contact area, are in direct electrical contact. This direct electrical contact signals electrical interface 321 and the system that flap 448 is in place and the ensuing key closures are related to records within booklet 440. It should be understood by those skilled in the art that wide variety of electrical contacts may be used.

The preferred embodiment of attachment means for securing of flap 448 to book 310, is described above as slot 326 and pocket 338. In an alternative embodiment, flap 448 is compressed and held in an operative position by a clamp. In still another embodiment two holes in the flap and two guide pins in the cover, register the flap 440 in operative position. This embobdiment is similar to ring binder arrangement, and indicates further alternatives.

Selection of a record space (332) and a sheet (345-367) within the automaticly identified arrays (71, 72, 73) or exchange booklets is made possible through manual actuation of dedicated keys as explained below.

FIG. 23 sets forth a typical data entry device 310, usually a book, constructed in accordance with the present invention. Sheets 345, 346, and 347, of array 71, are stacked upon rear cover 312. Sheet 345 is on top of the stack exposing face 345a. In this position the sheets are movably attached to spine 313 by a spiral wire, or by loose-leaf rings, or by other bookbinding means (not shown). Sheets 345-347 represent a sheet means for storing records. With simultaneous reference to FIGS. 23, 23a, 23b and 19, the embodiment is now explained in detail.

FIG. 23b sets forth a typical data entry device suppor 330, usually a book cover, having a front cover 311 and a rear cover 312. Front cover 311 and rear cover 312 are movably attached to spine 313 applying conventional book fabrication, and may be opened and closed accordingly. Covers 311 and 312 are formed of generally planar material like cardboard or plastic sheet. The front cover 311 supports a first plurality of depressible keys 384, 385 and 386 arranged in an equally spaced column near the

outer left edge and a second plurality of depressible keys 393 and 394 arranged in a equally spaced row near the upper edge. In a similar pattern, rear cover 312 supports a first plurality of depressible keys 381, 382 and 383 arranged in an equally spaced column near the right outer edge and a second plurality of depressible keys 391 and 392 arranged in a equally spaced row near the upper edge. It should be noted that keys 381-386 are record related keys, and keys 391-394 are sheet position related keys. Both represent a key means, or a switch means for selecting a sheet and a record, as explained below.

The structure of the keys, such as record related keys 381-386, and the sheet related keys 391-394 is explained in FIG. 18 in greater detail. The type of key structure selected is limited only by the physical constraints of the application. Referring again to FIG. 23b, rear cover 312 supports the electrical interface 321 along its upper edge, which includes connector 320 for communication with an outside system, such as computer system or data communication system. The codes (key closures and capacitance values) generated within the invention data book 310 are sent to the system via interface 321, which includes components and integrated circuits 421 necessary for producing the desired transmission format. An electro-optical display (not shown) is also typically included in interface 321. In the preferred embodiment, record related keys 381-386, and sheet related keys 391-394 are directly connected to predetermined pins in connector 320. In alternative embodiments, the record related keys 381-386, and sheet related keys 391-394 are connected to an integrated circuit encoder that converts a discrete key closure into a hexadecimal output, for example, which is sent to the system via connector 320.

A plurality of support-electrical elements 322, 323, and 324, usually support-capacitor plates, as explained in connection with FIG. 22b, are arranged in an evenly spaced column in the middle of the front cover 311. Similarly, connecting pads 377, 378 and 379, explained in connection with FIGS. 1a and 3, are arranged in an evenly spaced column in the middle of rear cover 312. Multiple conductor sets 317 and 318, representing a connection means, and provide electrical connections from key arrays 381-386, and 391-394, respectively, to electrical

interface 321. Similarly, conductor set 319 provides electrical connection from capacitor plates 322, 323, and 324, as well from connecting pads 377, 378, and 379 to electrical interface 321.

FIG. 23a is a vertically expanded sectional view of book 310 along line 23a-23a in FIG. 23. Front panel 314 covers the inner face of front cover 311. Front cover 311 and front panel 314 are paired and sealed together along the edges. Similarly, rear panel 316 overlies the inner face of rear cover 312. Rear cover 312 and rear panel 316 are paired and sealed together along the edges. Panels 314 and 316, are made of thin and flexible material and cover key arrays 381-386, and 391-394. Panels 314 and 316 carry visually marked key-press indexes 399, seen in FIG. 23, each key-press index being positioned over a respective key in key arrays 381-386, and 391-394, shown in broken lines. A slot 326 is formed in panel 314 and extended vertically parallel to the interior edge. The slot 326 provides access into a receiving pocket 338 defined between front cover 311 and overlying front panel 314. Similarly, a slot 328 is formed in panel 316. Slot 328 provides access into receiving pocket 339, defined between rear cover 312 and panel 316.

FIG. 23 shows face 345a of sheet 345 defining plurality of record spaces 332. Each record space 332 is located between two horizontal and doted lines, upon which visually imparted information is available, in readable or in other form, for operator reference. The types of information intended for storage in the record spaces include legends, symbols, labels, records, graphics, description of macro instructions, data strings, telephone numbers, and more. The three record spaces 332 on sheet face 345a are imprinted with the consecutive numerals *"1, 2, 3"*, respectively. These numerals are printed in the record spaces as labels for record keys 381, 382, and 383. Each record space 332 is aligned with, and adjacent to one of record keys 381-386. For example, label *"1"* is aligned with record key 381. In an alternative embodiment (not shown) the association between record keys and record spaces (instead of alignment) is made by indexes such as graphical pointer or alpha numeric designator. It should be understood that all sheets of arrays 71, 72 and 73 are provided with record spaces and label examples: sheet face 345b is provided with labels *"4, 5, 6"*, while sheet faces

346a and 346b bear labels "7, 8, 9" and "10, 11, 12", respectively (not shown). Each sheet provides along its upper edge at least one arrow-like sheet-index 341, 342, 343, 351, 352, 353, 353, 361, 362 and 363. Sheet-indexes 343, 353, and 363 are on the "b" face of the respective sheet of sheet arrays 371, 372, and 373, and therefore not visible in FIG. 19. The sheet-index location is unique for each sheet within one array. As the sheets are turned the sheet-index changes location. Sheet-index 341 points to sheet key 391, sheet-index 342 points to sheet key 392 (visible in FIG. 19), and so on.

What has been described in FIGS. 23, 23a, and 23b is a data entry book with a plurality of keys 381-386, and 391-394 positioned upon the covers, and a plurality of sheets 345, 346 and 347 each bearing a plurality of record spaces 332. Every record space aligns with a corresponding record key 381-386. When a sheet is turned there is another record space 332 that aligns with the same record key. For example three labels "1, 7, 13" located on sheet faces 345a, 346a and 347a respectively align with record key 81. Accordingly, turning over sheet 345, relabels record key 81 from "1" to "7", on sheet 346. Turning over sheet 346, relabels key 381 from "7" to "13", on sheet 347, and so on. This relabeling function offers the operator several labels per key-which is an object of the present invention.

Another object of the invention is to inform the system which particular label (record space) is selected by the operator. In order to do that the operator depresses one record key (381-386) aligned with the selected record space 332 (or with a record index), and then depresses one sheet key (391 -394) aligned with the sheet index (341, 342, 343, or 344) located on the sheet faces facing the operator in operative position. As shown in FIG. 23, sheet 345 is on top of the stack, and the first record space bears label "1" aligned with record key 381, while sheet index 341 is aligned with sheet key 391.

Still another object of the invention is to use the same keys (record key 381 and sheet key 391 identifying label "1", for example) for identification of labels "19" and "37" located on sheets 355 and 365 of sheet arrays 372 and 373, or of exchange booklets 440 and 450. This is made possible through applying sheet array identification or booklet identification, which

automatically provides codes (capacitance values) corresponding to the array, or booklet, in use (operation) as explaind above.

Table 2 illustrates the conditions for sending the system information about selection of a label (among the 54 labels) within data book 310 assembled with arrays 371, 372 and 373.

Table 2

Record Label	Located On Sheet	Face	Sheet Key	Record Key	Array In Use	Capacitance Value/Code
1	345	345a	391	381	371	C56 ≠ 0
2	345	345a	391	382	371	and
.						
4	345	345b	392	384	371	C67 ≠ 0
.						
.....						
19	355	355a	391	381	372	C56 = 0 and
20	355	355a	391	382	372	C67 ≠ 0
.						
.....						
37	365	365a	391	381	373	C56 ≠ 0 and
38	365	365a	391	381	373	C67 = 0
.						

Accordingly, label *"1"* located on face 345a of sheet 345, of array 371, designates keys 381 and 391 to be depressed while the data book is opened to expose sheet face 345a. In this position, array dividers 350, 360 and 370 are stacked in parallel on top of rear cover 312 (seen in FIG. 21a) and generate Capacitance Values/Codes C56 ≠ 0 and C67 ≠ 0, as indicated in Table 1. Under those conditions label *"1"* is correctly identified.

Now, selecting label *"19"* located on face 355a of sheet 355, of array 372, designates the same keys 381 and 391 to be depressed while the data book is opened to expose sheet face 355a, which positions the array dividers (as specified in Table 1) to generate Capacitance Value/Code C56 = 0 and C67 ≠ 0. Under those conditions label *"19"* is correctly identified.

Finally, selecting label *"37"* located on face 365a of sheet

365, of array 373, designates the same keys 381 and 391 to be depressed while the data book is opened to expose sheet face 365a, which positions the array dividers (as specified in Table 1) to generate Capacitance Value/Code C56 ≠ 0 and C67 = 0. Under those conditions label "37" is correctly identified.

The alternative embodiment with floating dividers in FIG. 21d generates corresponding capacitance values for sheet array in use (tabulated in Table 1) and accordingly provides the necessary information for label identification within the sheet arrays.

Similarly, the capacitance values produced by the exchange booklets 440 and 450 when inserted in data book 310, as described above, will identify selected labels in similar manner.

The relabelable keys, such as 100 in FIG. 5, 265 in FIG. 15, and 382 in FIG. 23a are supported by a book cover or the like. To achieve a thin and partially flexible book cover, the present invention employs low profile flexible diaphragm membrane type keys. It will be apparent, however, that many alternative keys may be used in the present invention. FIG. 18 sets forth a magnified section view of key 265 taken along section lines 18-18 in FIG. 15, and in general, shows key 382 in FIG. 23a. In the following reference is made to FIG. 23a. Book cover 312 formed of an insulating material supports a pair of conductors 317a and 317b. Insulating substrates 426 and 428 define an aperture 429 positioned above and centered upon conductors 317a and 317b. A flexible contact 387 is made of an electrically conductive material and is shaped as a dome. In its normal/open position, contact 387 is spaced from conductors 317a and 317b. A flexible panel 316 is supported upon substrate 428 and supports a downwardly extending projection 269. The thickness of substrate 428 is such that projection 269 is slightly distant from flexible contact 387. This levels flexible panel 316 and minimizes probability for unintentional key actuation. Sheets 375 are supported upon panel 316 in accordance with the above-described structures. In the position shown in FIG. 18, no pressure is applied to key 387 and as a result flexible contact 387 remains spaced from contacts 317a and 317b. However, if a downward force is applied by the operator to sheets 375, which in turn is transmitted to flexible panel 316 to force projection 269 against flexible contact 387. The downward flexing of panel 316 forces

contact 387 downwardly (shown in dotted line 387') into contact with conductors 317a and 317b producing an electrical connection therebetween. When the force is released, the resilience of flexible contact 387 and flexible cover 316 return flexible contact 387 to the normal/open position.

What has been shown is a multipage data entry book capable of providing relabeling and reassignment of a plurality of keys operative within the data book. The data sheets within the data entry book are configured to provide a capacitive and/or conductive indication of the relative positions of the sheets or the sheet arrays within the data book at any given position. This information is then available to provide reassignment and relabeling information for the plurality of keys within the data entry book.

While particular embodiments of the invention have been shown and described, it will be obvious to those skilled in the art that changes and modifications may be made without departing from the invention in its broader aspects. Therefore the aim in the appended claims is to cover all such changes and modifications as fall within the true spirit and scope of the invention.

THAT WHICH IS CLAIMED IS:

1. For use in a data entry device, a data entry substrate characterized by:

a base layer (11, 271, 333) of insulative material;

a first electrically conductive element (12, 272, 334) supported upon said base sheet; and

substrate connection means (27, 336, 31, 275) for making electrical connection to said first electrically conductive element.

2. A data entry substrate (10, 360, 270) as set forth in Claim 1 wherein said base layer includes a planar sheet (11, 333, 271) of insulating material defining first and second surfaces and wherein said first conductive element (12, 334, 272) defines a first layer (12, 334, 272) of conductive material upon a portion of said first surface.

3. A data entry substrate as set forth in Claim 2 wherein said substrate connection means includes a tail having a tail extension (14) extending from said base layer and a path (27) of conductive material extending from said first layer (12) of conductive material across and upon said tail extension (14).

4. A data entry substrate as set forth in Claim 3 wherein said tail is a wire (336, 32) bonded to said first electrical conductive element.

5. A data entry substrate as set forth in Claim 4 further including an insulative layer (13, 335) covering said first electrically conductive element (12, 334).

6. A data entry substrate as set forth in Claim 2 wherein said second surface includes and supports a second-surface electrical conductive element (273).

7. A data entry substrate as set forth in Claim 6 wherein said first electrical conductive element (272) and second-surface

conductive element (273) are electrically connected (Fig. 16).

8. A data entry book for use in data entry device having movably bound sheets with capability to be opened and expose writing areas, characterized by:

a plurality of data sheets (21-26, 81-86, 120-126, 180, 190, 230-235) each including an insulative base layer, an electrically conductive element (12) and tail extensions (14, 336) for making individual electrical connection to said conductive element;

a data book support (41, 42; 111, 112, 117; 201) for supporting said plurality of data sheets in a stacked array (81-85);

attachment means (43-45; 113-116; 140; 177; 204, 205, 237) securing said plurality of data sheets to said data book support in a pageable arrangement such that said data sheets overlie each other in said stacked array (21-26) and are pageable to open said book and form a first alternate stacked array (21, 22) and a second stacked array (23-26); and

support connection means (71-76) supported by said data book support establishing electrical connections to said tail extensions.

9. A data entry book as set forth in Claim 8 wherein said respective electrically conductive elements (12, 17, 272, 282) of said data sheets have overlying portions producing a plurality of capacitances therebetween.

10. A data entry book as set forth in Claim 9 wherein the capacitance (C23) between said conductive element of top data sheet (22) of first alternate stacked array (21, 22) and said conductive element of top data sheet (23) of second alternate stacked array (23-26) is substantially less than those capacitances within the stacked arrays.

11. A data entry book as set forth in Claim 10 wherein said data book support (41, 42; 111, 112, 117; 201) includes a planar support defining a support surface (203) and wherein said support connection means (71-76) include a plurality of connecting pads

(51-56; 215-220), conductors and electrical connector/interface (60, 68, 68') on said support surface.

12. A data entry book as set forth in Claim 11 wherein said tail extensions (91-96, 240-245) define staggered lengths and wherein said connection pads (51-56, 215-220) are correspondingly spaced on said support surface.

13. A data entry book as set forth in Claim 8 wherein said book support (201) further includes a plurality of depressible keys (265, 207, 208).

14. A data entry book as set forth in Claim 13 wherein said data entry sheets bear information labels (251) and keypress indexes (250) associated with said depressible keys.

15. A data entry book as set forth in Claim 8 wherein said data sheet (170) is divided into sheet sections (180, 190), each sheet section is individually movable, and each said sheet section includes one said electrical conductive element (12) and one said individual connection means (184, 194) to said electrical conductive element.

16. A data entry tablet (210) characterized by:

a plurality of data sheets (230-235) each including an insulative base layer having extending tail portions (240-245), a conductive area including a portion extending across said tail portion; and

binding means (205) maintaining said data sheets in a stacked array such that said tail portions extend in a common direction.

17. A data entry tablet (210) as set forth in Claim 16 wherein said base layers define a common edge and wherein said tail portions of each of said base sheets extend from said common edge thereof.

18. A data entry tablet (210) as set forth in Claim 17 wherein said tail portions of said data sheets form a stacked array and

are staggered in length (Fig. 13).

19. A data entry tablet support (200) for use in supporting a plurality of data entry sheets (230-235), said tablet support characterized by:

a base (201) defining a planar support surface (203);

a cover member (204) hingeably attached to said base and movable between an open position away from said support surface and a closed position overlying said support surface to captivate data entry sheets (230-235) therebetween;

a plurality of electrical connecting pads (215-220) supported upon said support surface (203); and

connection means for making electrical connection to said connecting pads.

20. A data entry tablet support (200) as set forth in Claim 19 wherein said connecting pads are arranged in rows beneath said cover member.

21. For use in entering data into an information system, a data entry book characterized by:

a plurality of insulative data sheets (81-86, 230-235);

a plurality of conductive elements supported upon said data sheets (272, 273);

means for supporting (41, 42, 201) and securing (43, 44, 45, 236, 237, 204, 205) said data sheets in a stacked array in which said conductive elements generally overlie each other, said data sheets being pageable from said stacked array to open said data entry book to a selected data sheet; and

connecting means for making electrical connection to each of said conductive elements (66, 76, 56, 96),

whereby the open sheet in said stacked array may be determined by sensing the electrical properties between said conductive elements.

22. For use in an electronic data entry device, at least two writable and printable data substrates, joined at least at one point when in first operative position and separated at said point when in second operative position, each substrate

characterized by:

a base layer of insulative material (11, 333, 271);

a first electrical element (12, 272) supported upon said base layer.

23. A data substrate as set forth in Claim 22 wherein said data substrate comprises a connection means (14, 336, 275) for making electrical connection between said first electrical element and an external element (56, 220).

24. A data substrate as set forth in Claim 23 wherein said base layer includes a planar substrate (271) of insulating material defining first and second surfaces and wherein said first electrical element defines a first layer of conductive material (272) upon a portion of said first surface.

25. A data substrate as set forth in Claim 24 wherein said connection means includes a tail having a tail extension (14) extending from said base layer and a path of conductive material (27) extending from said first layer of conductive material across and upon said tail extension.

26. A data substrate as set forth in Claim 25 wherein said connection means is wire (336).

27. A data substrate as set forth in Claim 26 further including multiple electrical elements (272, 273) supported upon said base layer.

28. A data substrate as set forth in Claim 27 further including connection means (275) for making electrical connections between said multiple electrical elements and external elements (56, 220).

29. A data substrate as set forth in Claim 28 further including an insulative layer (13, 335) covering said first electrical element and said multiple electrical elements.

30. A data substrate as set forth in Claim 29 wherein said

second surface supports a second-surface electrical element (273)

31. A data substrate as set forth in Claim 30 wherein said first electrical element and said second-surface electrical element are electrically connected.

32. A data substrate as set forth in Claim 31 further including an insulative layer covering said first electrical element and said second-surface electrical element.

33. A data entry book as set forth in any one of Claims 8-32 wherein the electrical property sensed to determine the open sheet is capacitance.

34. A data entry book as set forth in any one of Claims 8-32 wherein the electrical property sensed to determine the open sheet is electrical conductance.

35. A data entry book as set forth in any one of Claims 8-32 wherein the electrical condition sensed to determine the open sheet is human touch.

36. A data entry book as set forth in any one of Claims 8-32 having binding means (113-116; 177) attached to data book support (41, 42; 111, 112, 117) for movably holding said substrates characterized by,

an opening formed within said binding means providing housing for portion of connecting tails or wires (14, 334) of said substrates.

37. A data entry book as set forth in any one of Claims 8-32 having protective overlay (140) characterized by,

a generally cylindrical body (140) providing housing for portion of connecting tails or wires (14, 334) of said substrates.

38. A data entry book (FIG. 21a) for use in data entry device having movably bound sheets arranged in sheet arrays, by array dividers, with capability for automatic identification of the

sheet array that is opened to expose any sheet characterized by:

sheets (345-347, 355-357, 365-367) of dielectric material;

dividers (350, 360, 370) of insulative material supporting divider electrical element (334);

a device support (311, 312) for supporting said sheets and said dividers;

attachment means for movably attaching said sheets and said dividers to said device support;

an electrical interface (320) supported upon/within said device support providing connections to an external device;

connection means (336, 319) supported by said device support making connections from said divider electrical elements to said electrical interface.

39. A data entry book of claim 38 wherein said dividers are interleaved/inserted between said sheets dividing said sheets into data sheet groups (71, 72) and said electrical elements are thin layers of conductive material.

40. A data entry book of claim 39 wherein two consecutive dividers are positioned in stacked generally parallel relation separated by at least one of said sheets to form a parallel plate capacitor having a maximum capacitance value.

41. A data entry book of claim 40 wherein said two consecutive dividers are in open position to form an open dividers capacitor having a minimum capacitance value.

42. A data entry book (FIG. 21d) for use in data entry device having movably bound sheets arranged in sheet arrays, by array dividers, with capability for automatic identification of the sheet array that is opened to expose any sheet characterized by:

at least one array of sheets (373') for record storage, said array of sheets having a top sheet;

at least a first floating array divider (360'), each floating divider having at least one electrical element (334);

a device support (312') for supporting said sheet arrays and said floating dividers, said device support means having at least two device support electrical elements (324',

325');

attachment means for movably attaching said sheets (373') and said floating dividers (350', 360') to said device support (312');

the floating divider (360') being positioned to be the top sheet substantially in parallel with the device support electrical elements (324', 325'), the floating divider being separated from the support electrical elements by the array of sheets (373') to form a parallel plate capacitor having a max value to signal that the array of sheets is in a closed position;

the parallel plate capacitor having a min capacitance value in response to said floating divider being opened away from the top sheet to signal that the sheet array is opened;

connection means (336, 319) for making connections from said device support electrical elements (324', 325') to said electrical interface (320, 321).

43. A data entry book with automatic exchange booklet identification characterized by:

at least one exchangeable booklet (440) having at least one sheet (445) for record storage and a flap (448) bearing at least one electrical element (449), said flap electrical element completing a signal path for automatic identification of said flap;

an electrical interface means (320, 321) for connecting the data entry device to an external device;

a device support (312) having a set of support electrical elements (377, 378, 379) for cooperation with said flap electrical element, and having means for releasably coupling the flap electrical element to the support electrical elements, the electrical interface being supported by the common support;

a connection means (319a, 319b, 319c) for electrical connection of said support electrical elements to said electrical interface, said connection means being supported on said device support;

44. The data entry book of claim 43 wherein said flap electrical element is a thin conductive layer (334) forming a capacitor plate, said plate being covered by a thin insulative film (335).

45. The data entry book of claim 44 wherein said support electrical elements are formed of a thin conductive layer (334) to form at least one capacitor plate, said plates being covered by a thin insulative film (335).

46. The data entry book of claim 45 wherein said means for releasably coupling is a receiving pocket (339) formed in said device support.

47. The data entry book of claim 46 wherein said flap capacitor plate is located upon said flap such that when said flap is inserted in said receiving pocket said flap capacitor plate overlies at least two of said cover capacitor plates (377, 378, 379) to form two capacitors wherein said flap capacitor plate is a common capacitor plate of said two capacitors.

48. The data entry book of claim 47 wherein said flap capacitor plate is positioned on said flap such that in operative position to form at least two predetermined capacitors with said device support capacitor plates.

49. The data entry book of claim 48 wherein said at least two predetermined capacitors are unique/characteristic for each booklet.

50. The data entry book of claim 49 wherein said exchange booklet when inserted in operational position is aligned with the support.

51. The data entry book of claim 50 wherein said flap capacitor plate and said support capacitor plates are free of insulative film thus establishing direct electrical contact therebetween when said flap is inserted in said receiving pocket.

52. The data entry book of claim 51 wherein said flap and sheets are movably joined at least one point.

53. A data entry book (310 in FIG. 23) for use in data entry

device having movably bound sheets with capability to be opened and expose writing areas, characterized by:

a data book support (311, 312, 313);

a sheet means (345, 346, 347; 71) of dielectric material for storing records at predetermined locations, said sheet means having

at least one sheet, each sheet having

at least one record space (332) for receiving information, and

a switch means (391, 392; 381, 382) for selecting a sheet and a record space, having

at least one sheet key associated with each sheet

at least one record key associated with each record;

an electrical interface (321) for connecting said data book to an external device/system;

a connection means (317, 318) for connecting each sheet key and each record key to said electrical interface;

at least one support electrical element (22-24; 77-79);

each said support electrical elements being connected via said connection means to said electrical interface; and wherein

said data book support is further characterized to have a sheet attachment means for securing said sheet means in a stackable arrangement such that said sheets may be moved back and forth, said data book support providing space (314, 316) on which said sheets means are supported; and wherein

said data book support is further characterized to support said sheet keys, said record keys, electrical connection means, and said electrical interface.

54. The data book of claim 53 wherein said sheet means further comprises:

at least two groups of sheets (371, 372), each of said two groups of sheets having at least one sheet;

a divider means (350, 360) separating said groups of sheets for automatic group of sheets identification;

at least one divider electrical element (334).

55. The data entry book of claim 54 wherein each said divider electrical element is connected to said electrical interface.

56. The data entry book of claim 55 wherein each said divider electrical element is a capacitor's plate.

57. The data entry book of claim 56 wherein at least two consecutive dividers (350, 360) are separated by a respective interposed groups's plurality of sheets (372).

58. A data entry book support as set forth in any one of Claims 8-57 wherein said support (42, 112, 203, 312, 316) defines a support area which data entry sheets (81-85, 120-123, 180, 190, 230-235, 345-347, 355-357, 375, 445-447) overlie when supported by said data entry book support and an outside area adjacent said support area.

59. A data entry book support as set forth in Claim 59 further including a first plurality of depressible keys (101, 265, 382) supported within said data book support area and depressible through the data entry book sheets.

60. A data entry book support as set forth in Claim 59 further including a second plurality of keys (207, 208, 391) supported upon said outside area.

61. A data entry book for use in data entry device as set forth in any one of Claims 8-60 wherein said relabelable, sheet keys, record keys and function keys are low profile membrane keys.

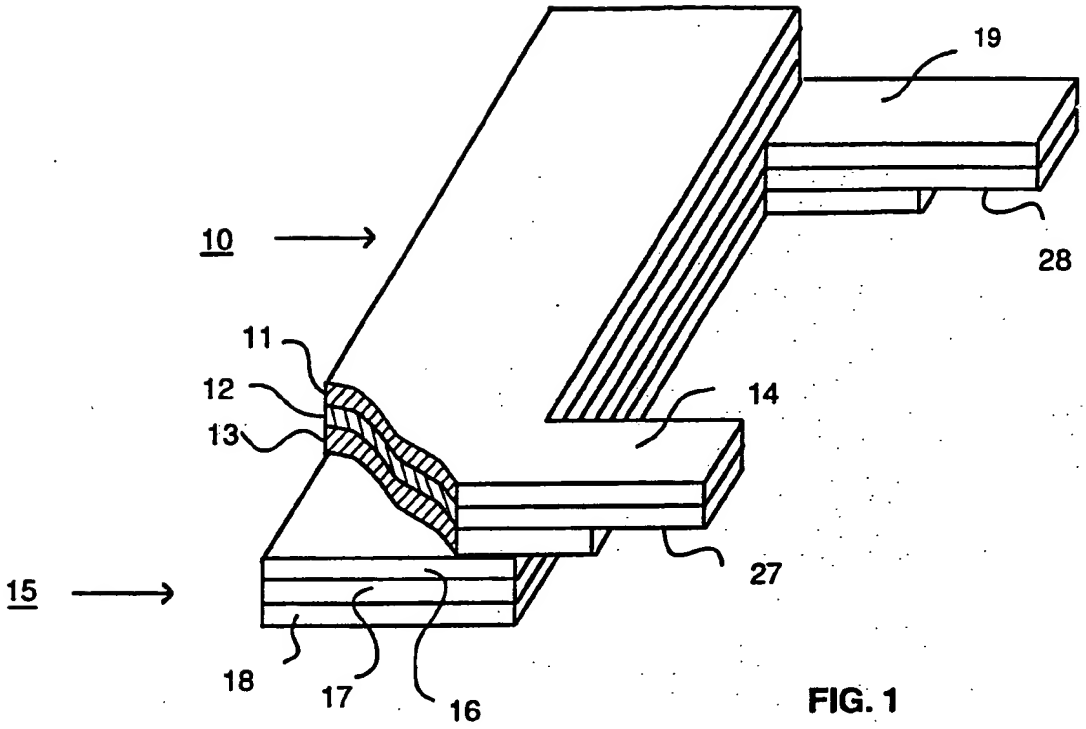

FIG. 1

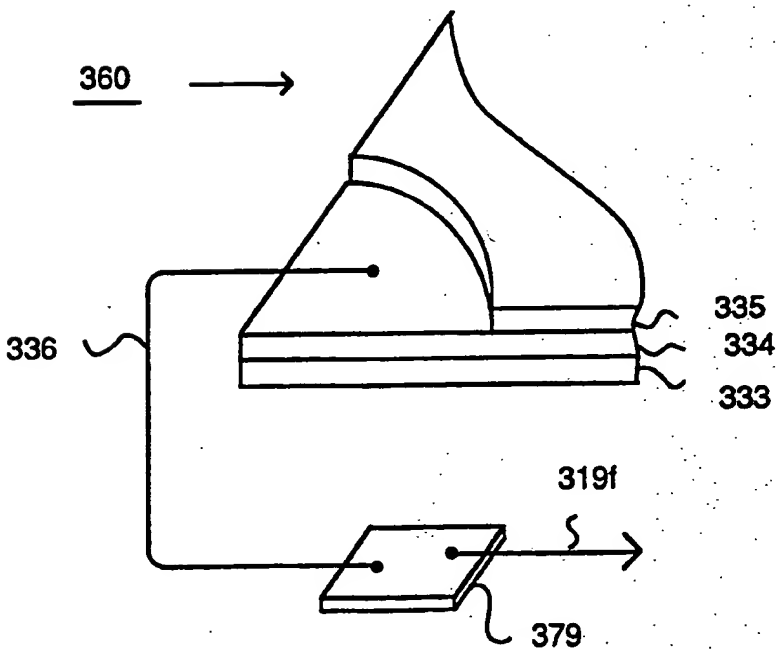

FIG. 1a

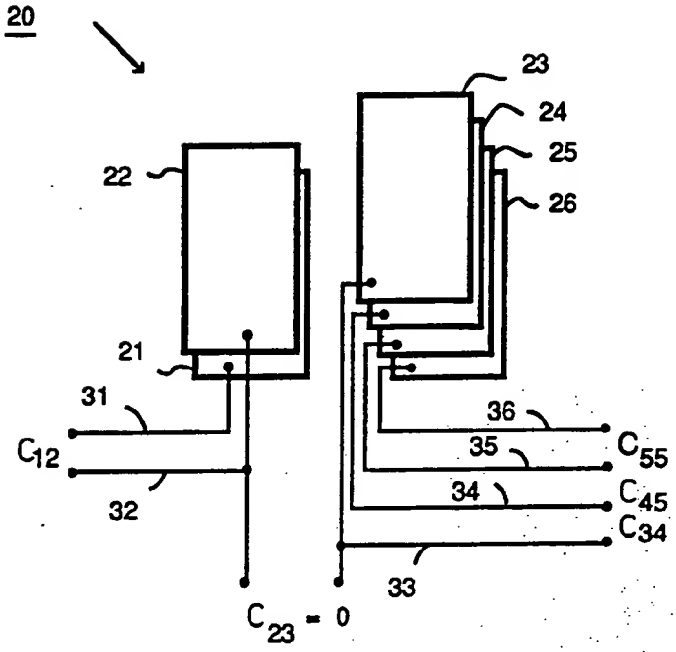

FIG. 2

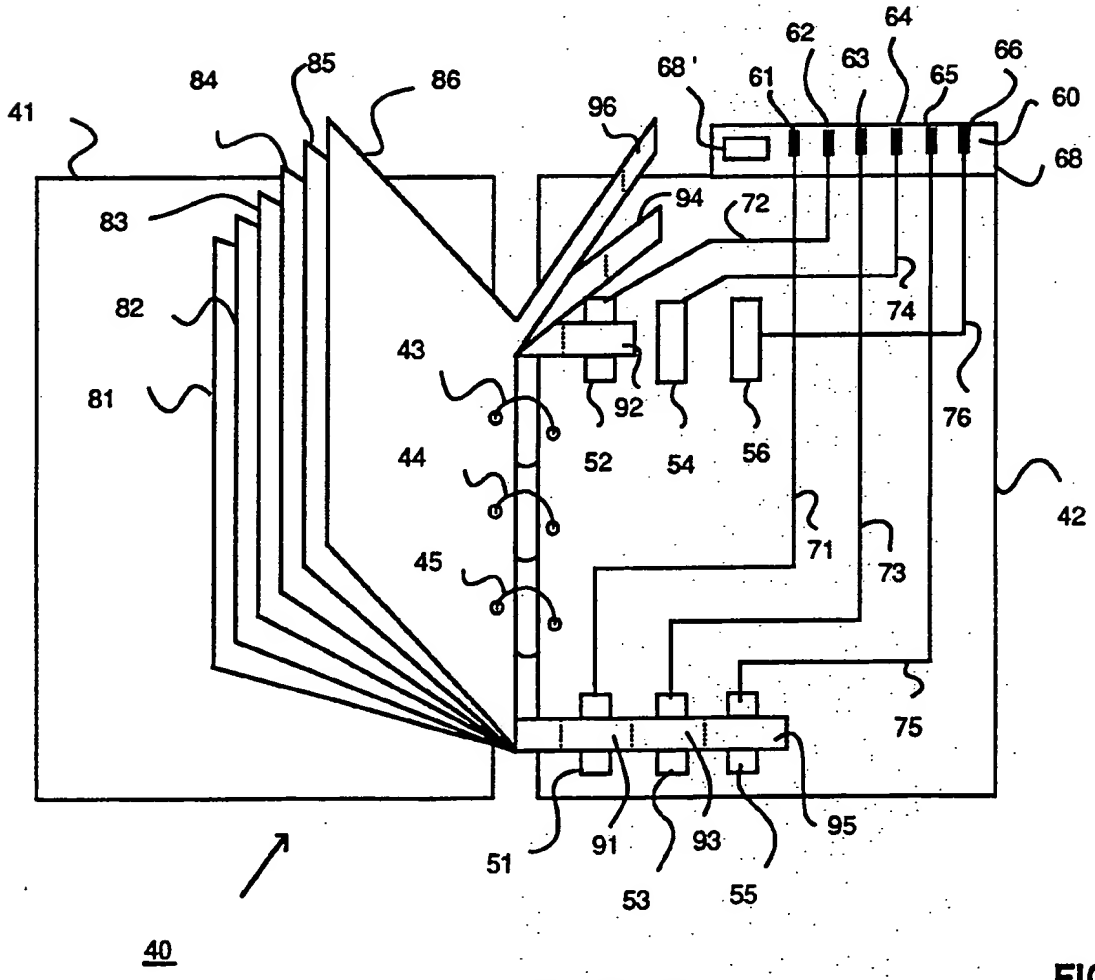

FIG. 3

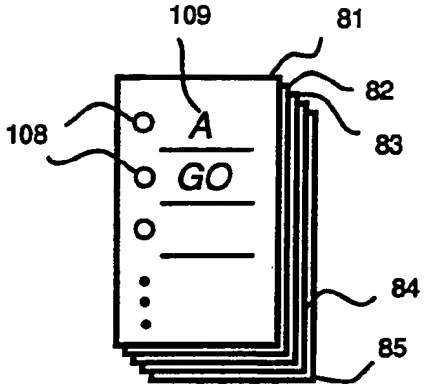

FIG. 4

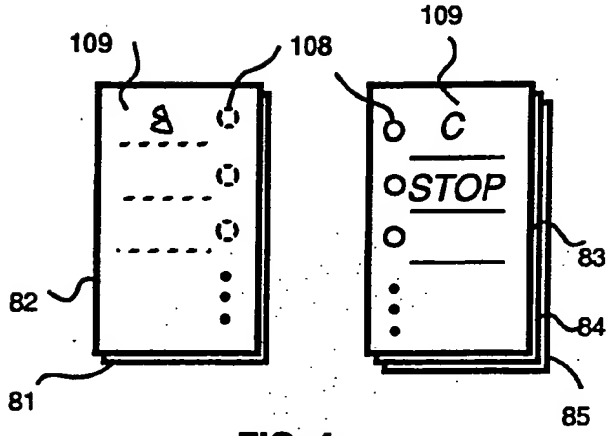

FIG. 4a

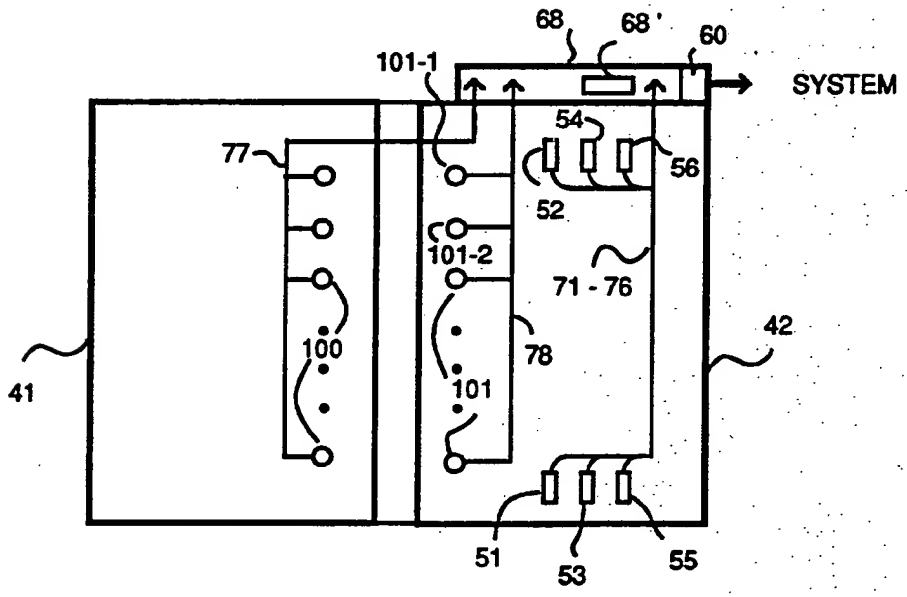

FIG. 5

KEY-REASSIGNMENT TABLE

SELECTED		KEY-REASSIGNMENT PARAMETERS	
LABEL	ON SHEET	SHEETS OPEN	KEY DEPRESSED
A	81	NONE	101-1
B	82	81,82	101-1
C	83	82,83	101-1
D	84	83,84	101-1
E	85	84,85	101-1
GO	81	NONE	101-2
STOP	83	82,83	101-2

FIG. 5a

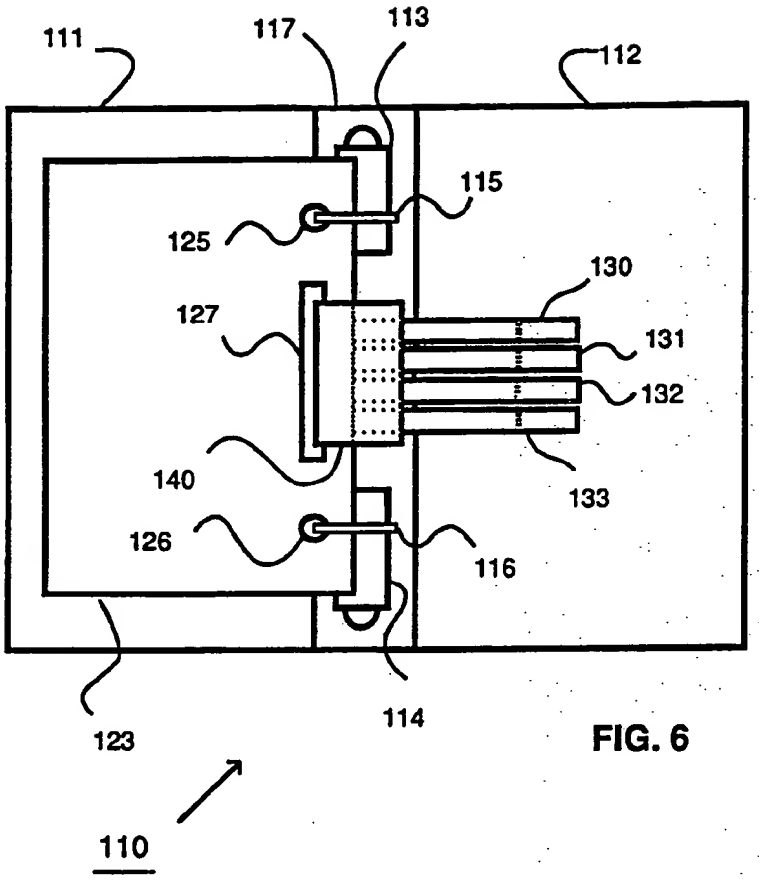

FIG. 6

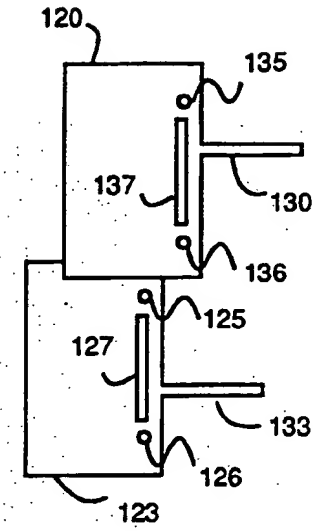

FIG. 7

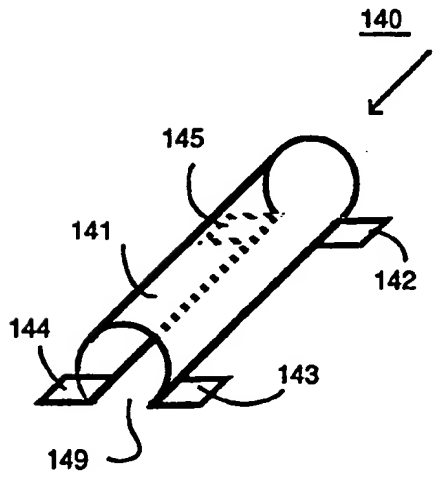

FIG. 8

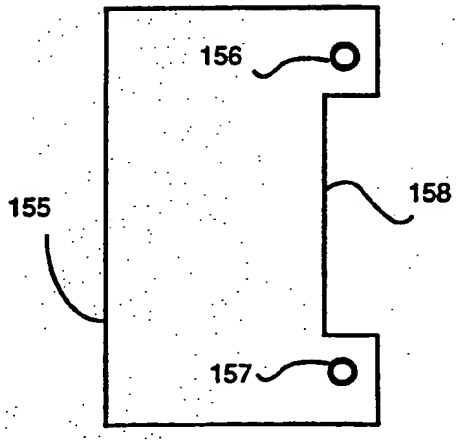

FIG. 9

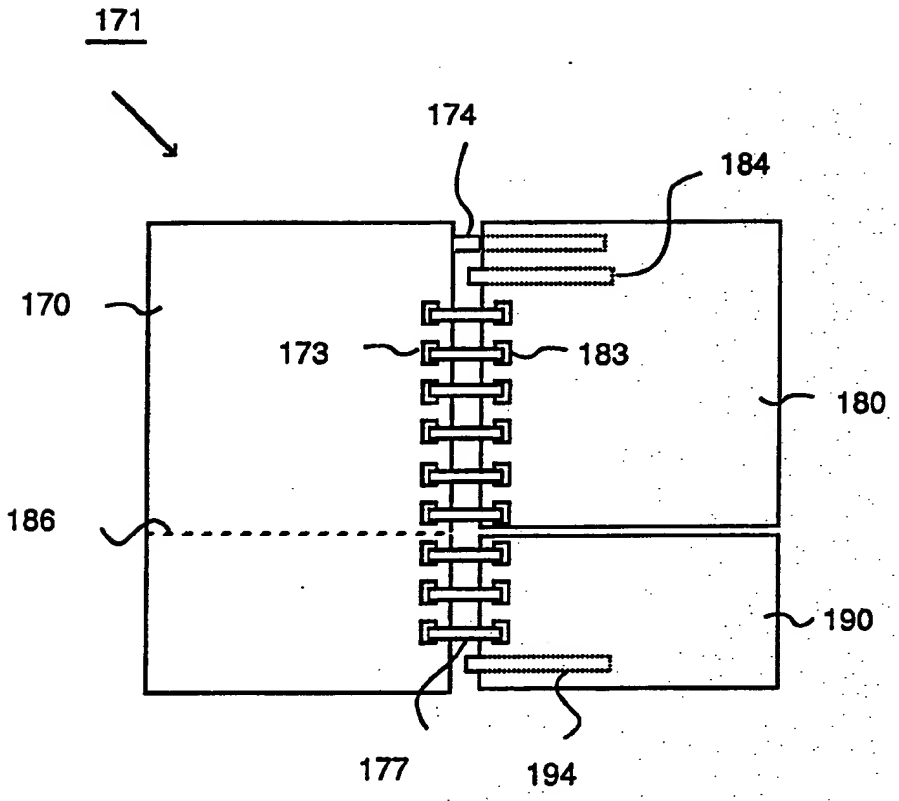

FIG. 10

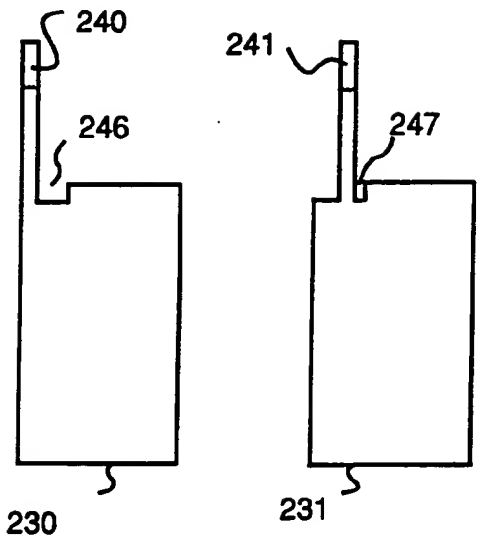

FIG. 11

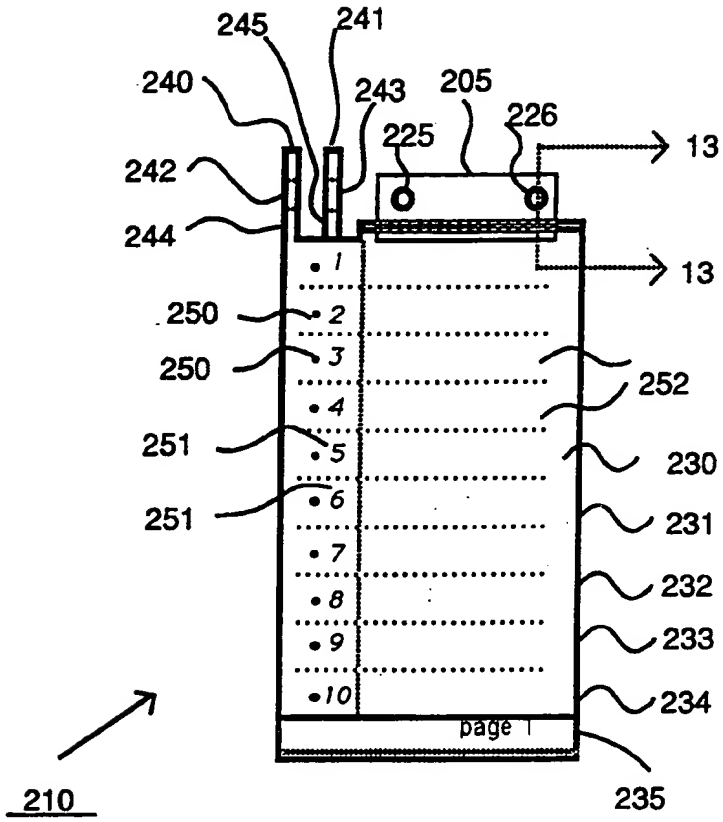

FIG. 12

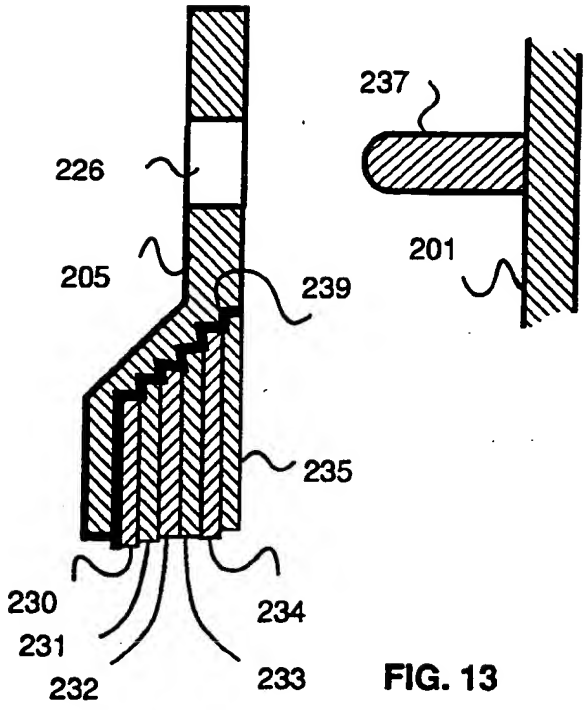

FIG. 14

FIG. 13

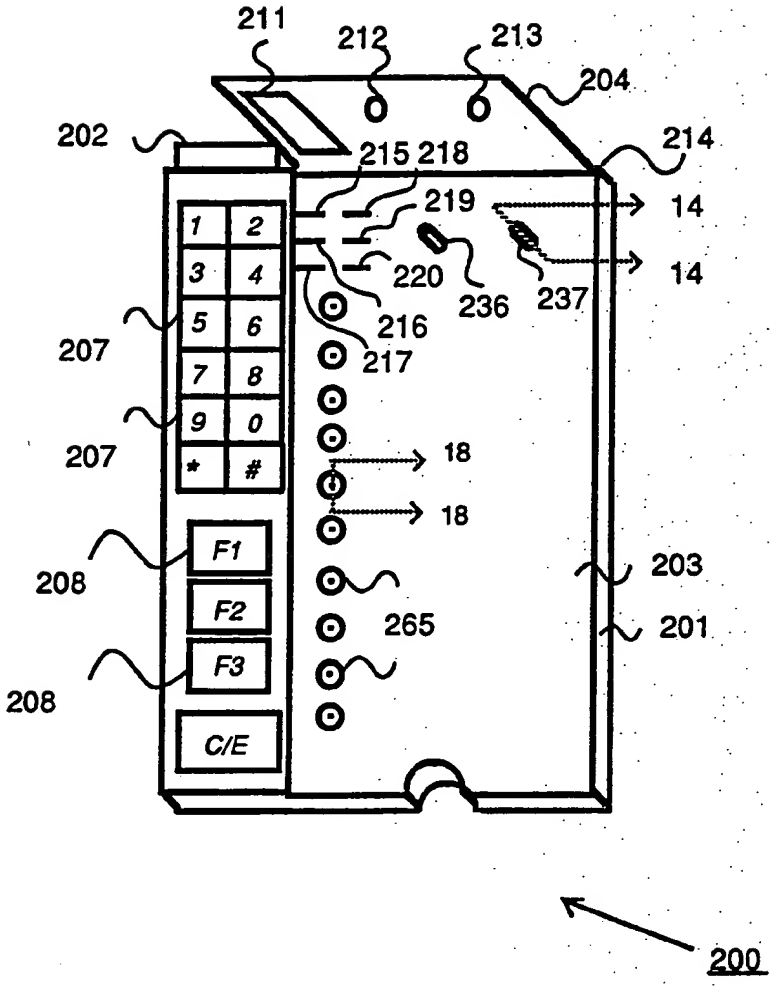
211
212
213
204
202
215 218
214
219
14
14
220
236
237
216
217
207
207
1
2
3
4
5
6
7
8
9
0
*
#
18
18
F1
F2
F3
C/E
208
208
203
201
265
200

FIG. 15

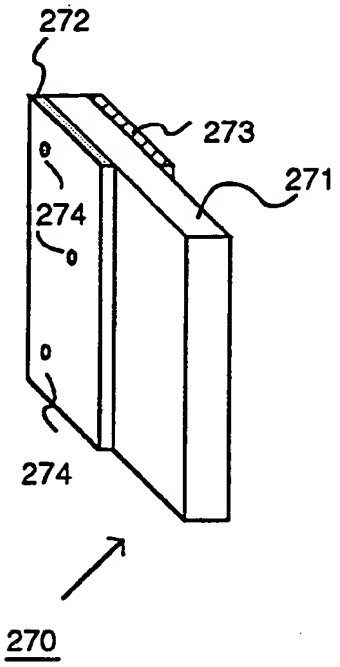

FIG. 16

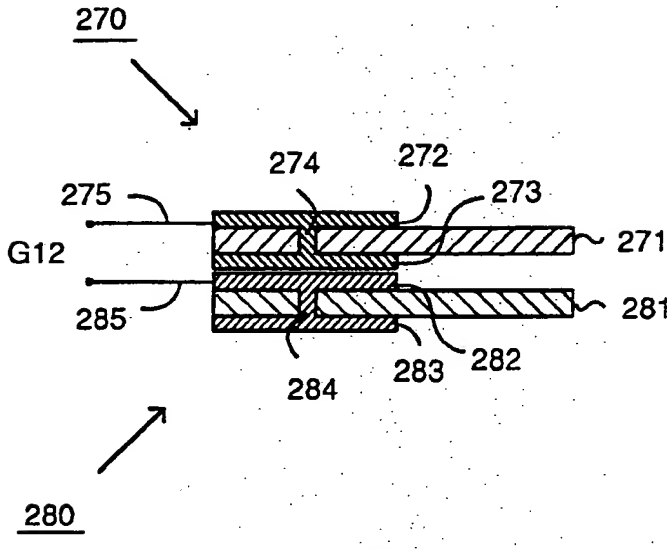

FIG. 17

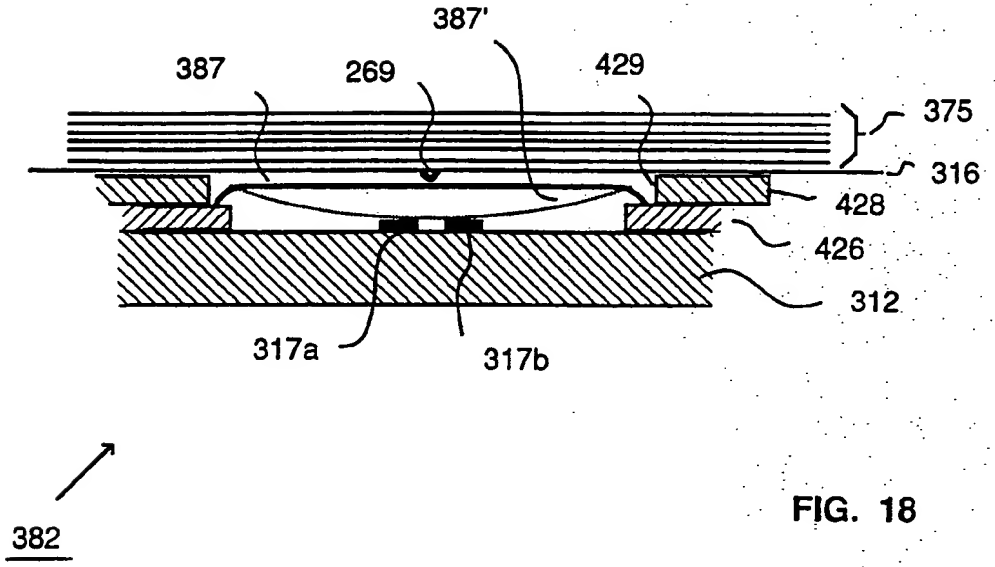

FIG. 18

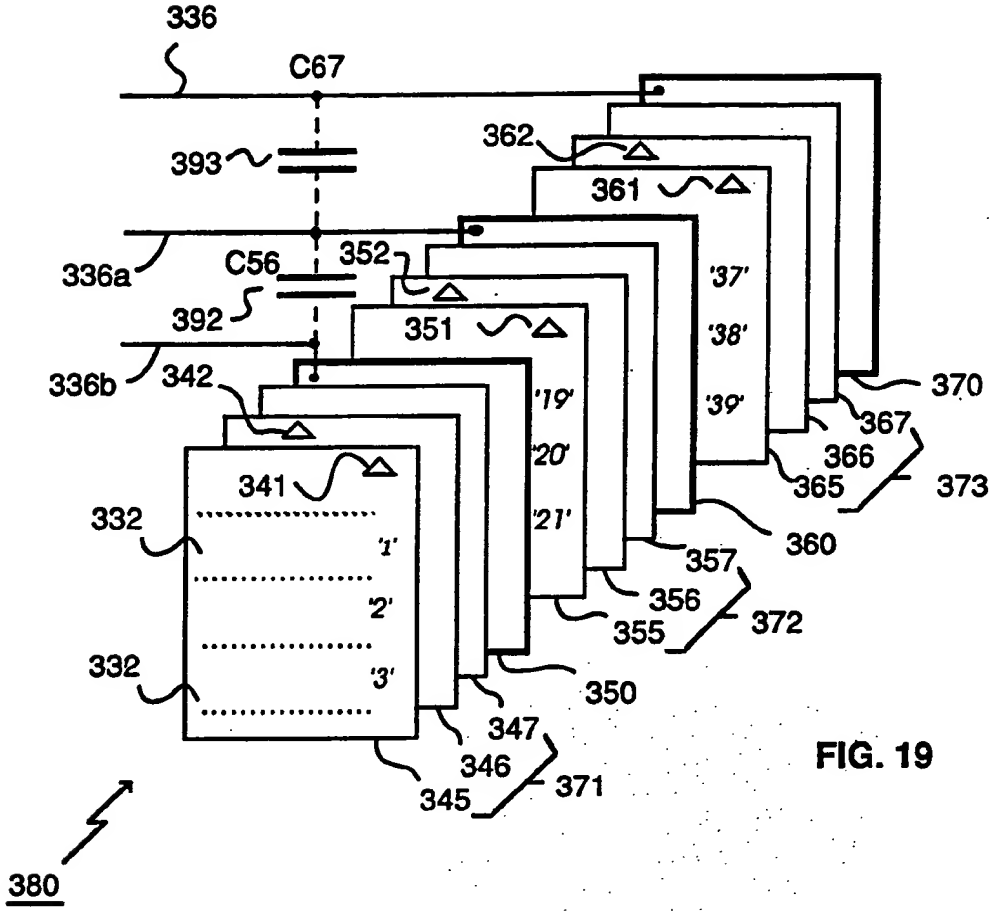

FIG. 19

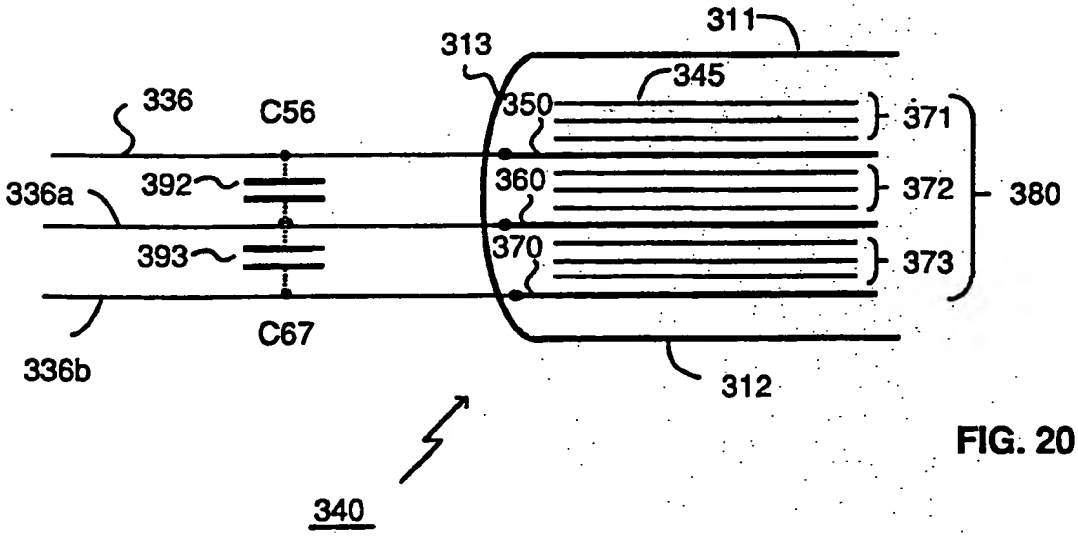

FIG. 20

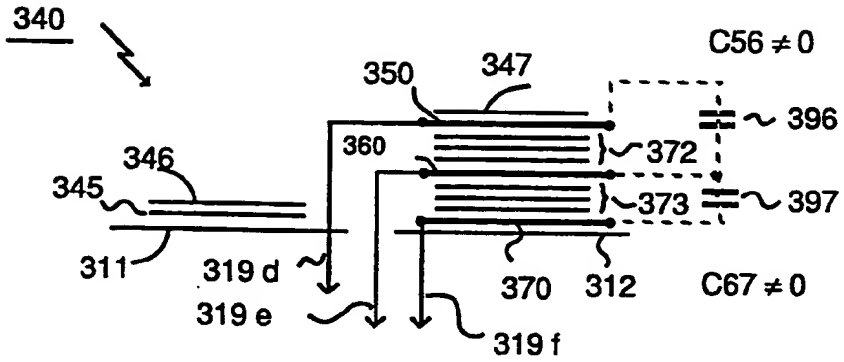

FIG. 21a

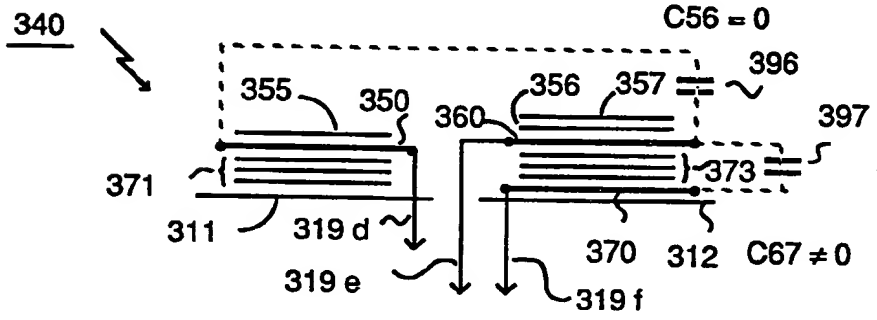

FIG. 21b

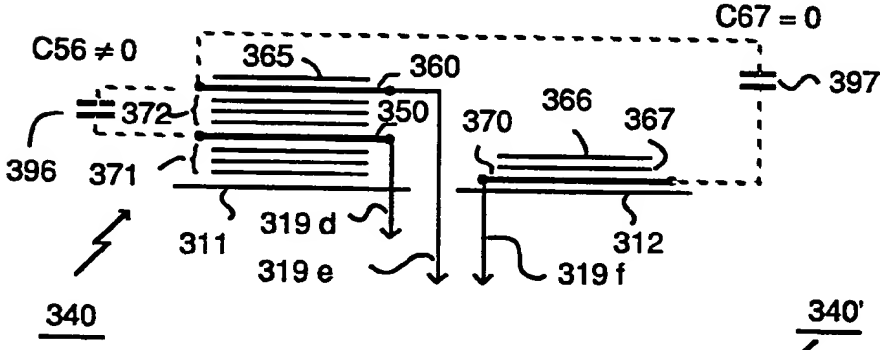

FIG 21c

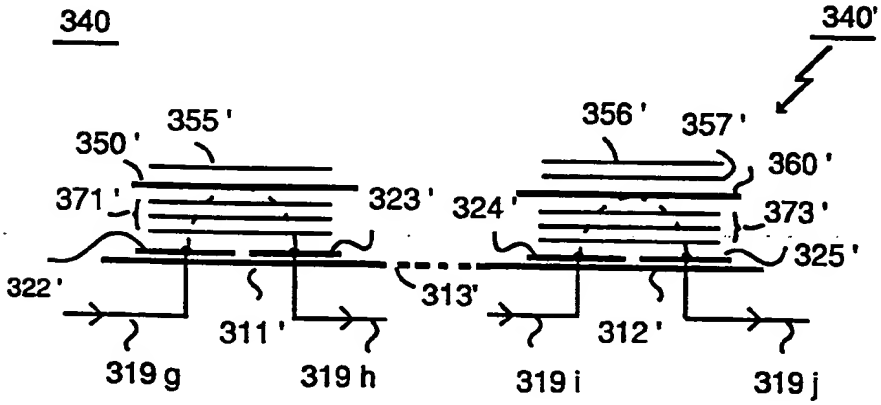

FIG. 21d

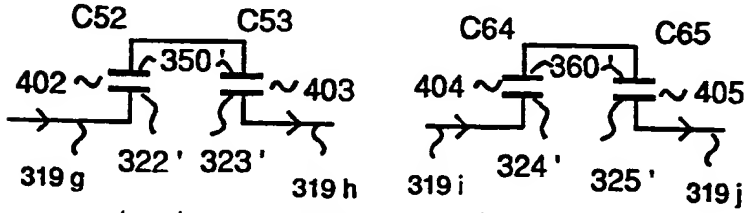

FIG. 21e

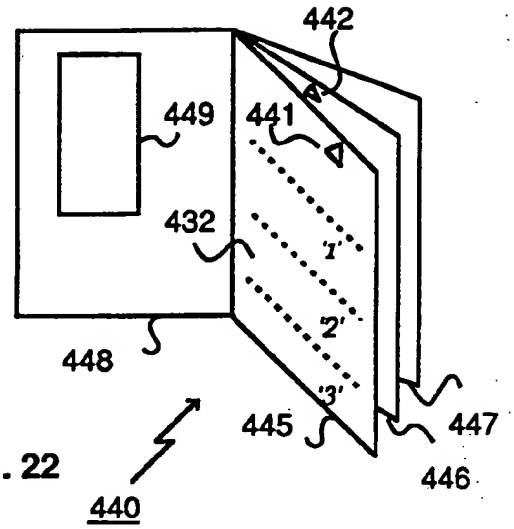

FIG. 22

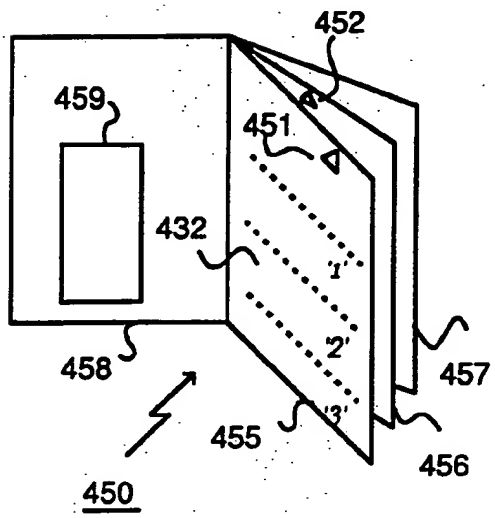

FIG.22a

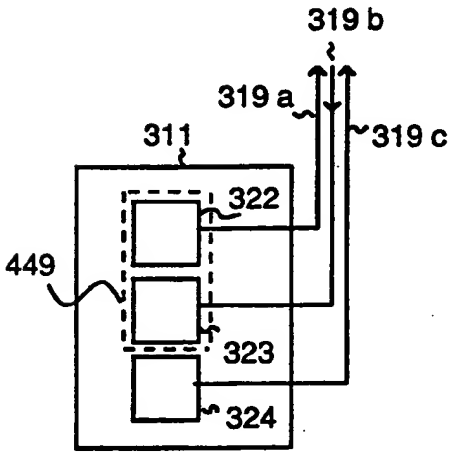

FIG. 22b

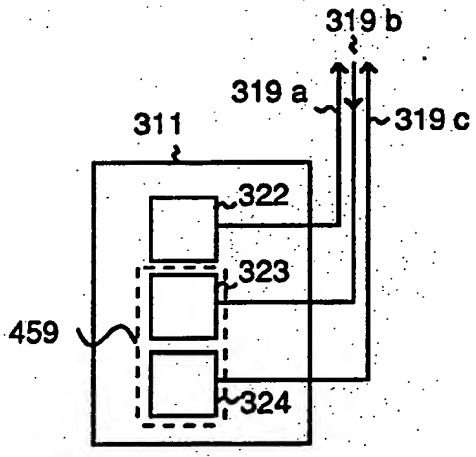

FIG. 22c

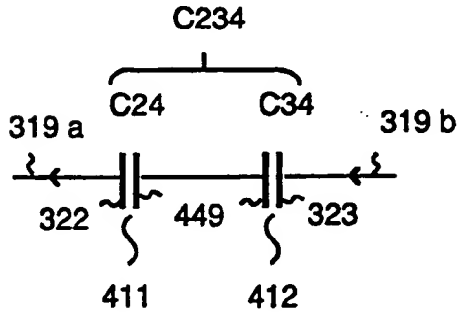

FIG. 22d

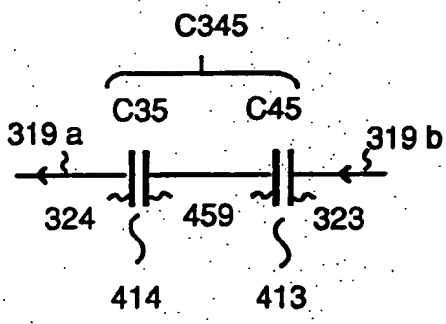

FIG. 22e

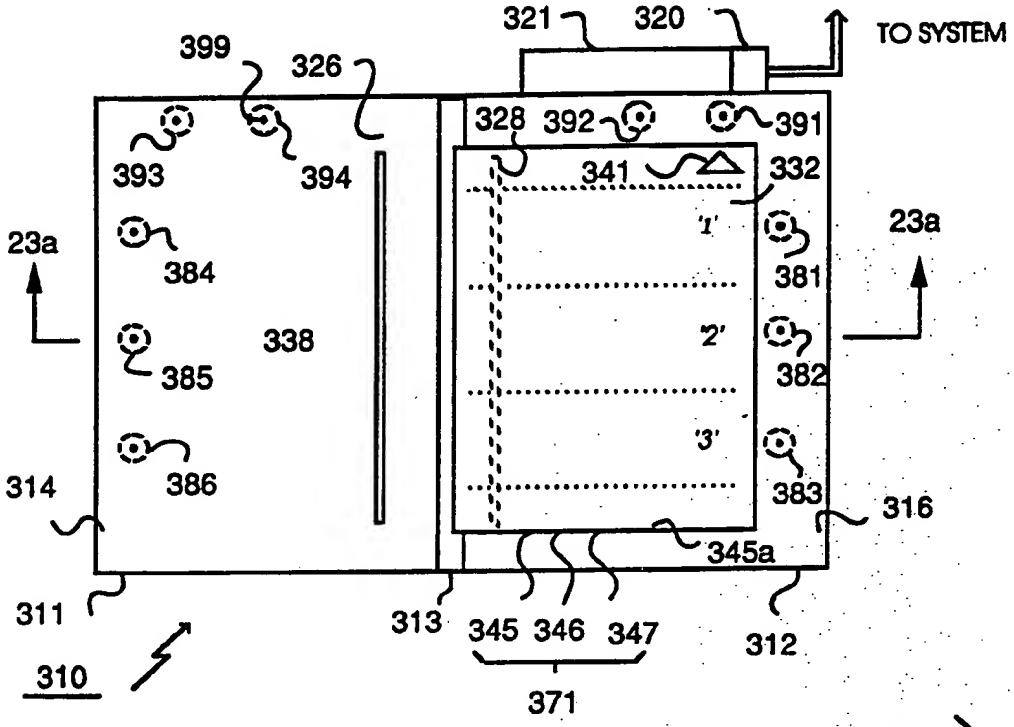

FIG. 23

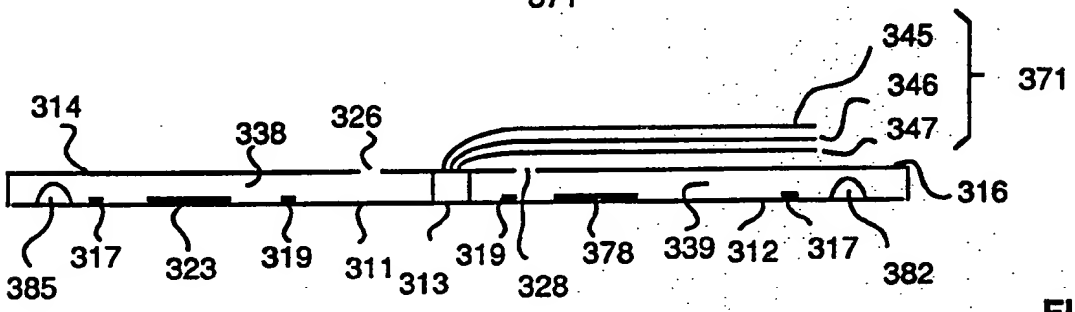

FIG. 23a

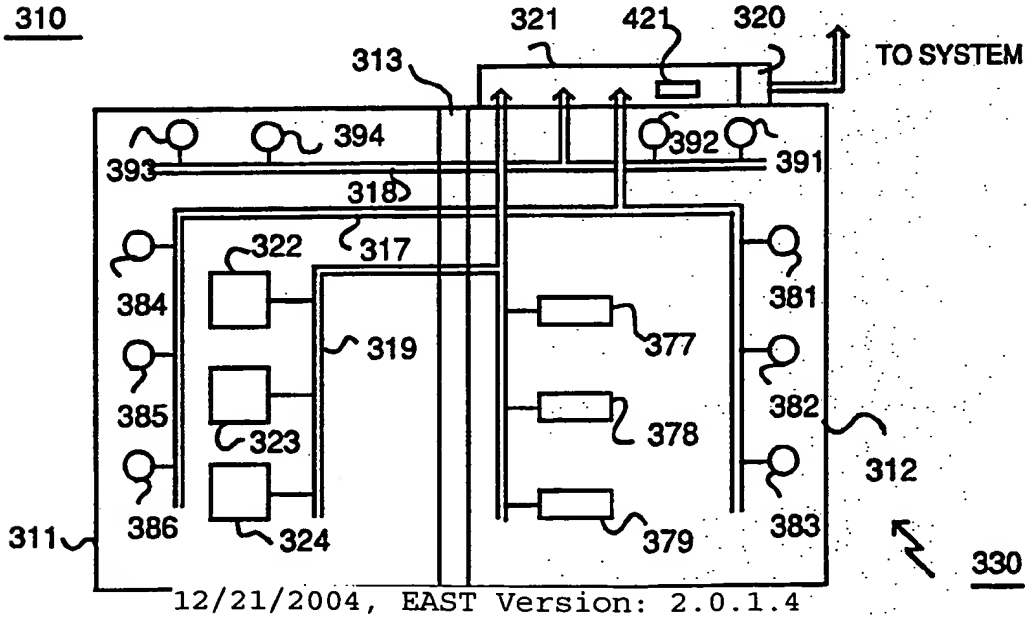

FIG. 23b